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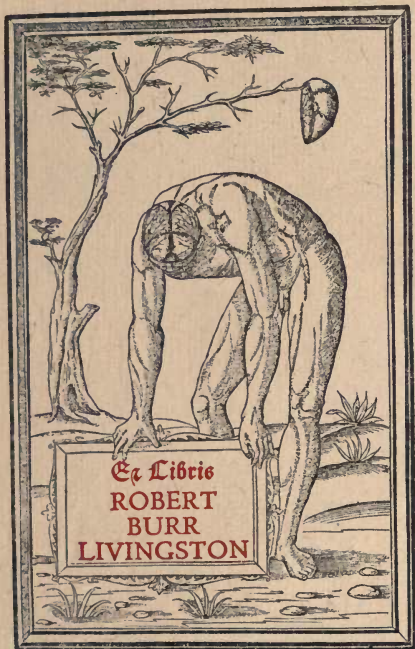


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# Vicious Circles in Disease



J. B. HURRY



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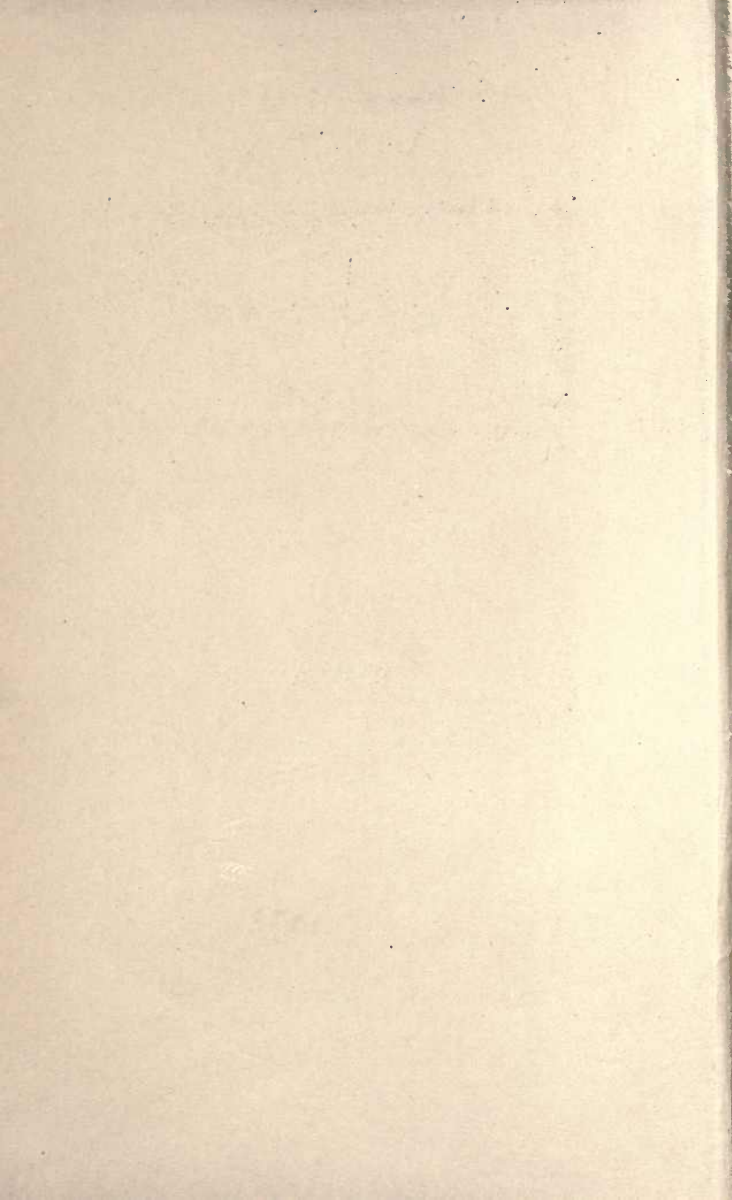




Vicious Circles

in

Disease







(a) CARDIAC FAILURE



(b) PULMONARY TUBERCULOSIS

# **Vicious Circles** **in** **Disease**

BY

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Author of "Poverty and its Vicious Circles,"  
Etc., Etc.

**With Illustrations**

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1919





**M**edicis  
**M**edicus  
**H**oc **O**pus



# Preface to the First Edition.

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THIS MONOGRAPH represents the first attempt to deal systematically with Vicious Circles in Disease, and is offered to the Profession with a full consciousness of many shortcomings.

Such an exploration into a new field of pathological enquiry needs no small circumspection. But care has been taken to quote freely from recognised authorities so that the reader will have before him the evidence for the propositions advanced.

The array of Vicious Circles brought together appears so overwhelming in its cumulative weight as to justify the conclusion that such Circles play a rôle of great importance in pathology. If this view is correct, the subject is one which no practitioner of the *ars medendi* can afford to neglect. Its study will conduce to increased accuracy of diagnosis, prognosis and treatment. Especially in regard to treatment will there be gain, for full of truth is the old maxim : *Qui bene diagnoscit bene medebitur.*

Most of the Chapters have appeared in the columns of the *British Medical Journal*, *The Lancet*, *The Practitioner* and the *Medical Press*, and I am indebted to the courtesy of the respective Editors for permission to reprint. My thanks are also due to many friends for assistance and encouragement.

My friend Dr. Harry Campbell has kindly read through the proof-sheets.

J. B. H.

WESTFIELD, READING.

February 1st, 1911.





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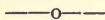
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# Introduction.



VICIOUS Circle in pathology (*circulus vitiosus*, cercle vicieux, Zirkelschluss, circolo vizioso) is defined in Murray's *New English Dictionary* as "a morbid process consisting in the reciprocal continuation and aggravation of one disorder by another." In other words the process represents such a reaction of a disorder on its cause that such cause is perpetuated or intensified. Cause becomes effect and effect cause.

This meaning of Vicious Circle is transferred from its earlier use in logic where the expression connotes a fallacious mode of reasoning in which a proposition is used to establish a conclusion, and is afterwards proved by means of the conclusion which it has been used to establish.

Although the expression Vicious Circle has been used by pathologists for over a century and enjoys the advantage of brevity, it is not altogether a fortunate one, conveying as it may do the idea of form rather than of process or action. From this point of view the expression "circular reaction" introduced by Prof. J. M. Baldwin to designate "a condition which keeps itself going by reproducing the conditions of its own stimulation" is preferable. A further advantage of this term is that it may be applied to reciprocally acting physiological as well as pathological processes, such a prefix as beneficent or injurious, healthy or morbid being added as required. On account of its hoary antiquity the term Vicious Circle has been retained in the title of this Book in spite of the objection referred to. In the letterpress both expressions are used.

Vicious Circles play a part of immense importance in the mechanism of disease. They are responsible for the perpetuation and aggravation of morbid processes, for the destruction of organs, for the ending of life itself. A large proportion of all deaths are accelerated by the intervention of this complication, a result which applies as much to the animal as to the vegetable kingdom.

This subject has hitherto received but little attention from either the zoo-pathologist or the phyto-pathologist. No "system of medicine" discusses the pernicious influence of the Vicious Circle on the progress of disease; no text-book of therapeutics guides the practitioner in his search for the *locus minoris resistentiæ*, so that *natura medicatrix* may once again resume her beneficent sway.

In the normal course of events, the reactions provoked in response to injury are of a kind calculated to promote recovery. Such disorders may be described as self-limiting and the main task of the physician is to further and control such beneficent reactions as tend to readjustment.

On the other hand when disease is complicated by injurious reactions the art of therapeutics is confronted with problems of greater complexity. The physician has no longer merely to deal with a morbid process which Nature is doing her best to rectify. So far as the factors that go to make up the pernicious sequence are concerned, her beneficent influence becomes maleficent. The *vis medicatrix* becomes the *vis vastatrix*; the gyration must be arrested before recovery can take place.

A great advantage of isolating the process of the Vicious Circle for separate study is that such isolation conduces to clearness of thought and to an insight into the complex processes involved. Moreover such isolation assists in the philosophical grouping of a mass of facts which otherwise would

remain *membra disjecta* and allows such facts to be arranged in their several niches of pathological phenomena. Specialisation is an application of the common-sense principle "one thing at a time," and is a valuable aid to research, so long as other aspects of a problem are not lost sight of. The search for such inter-dependences supplies a good discipline for the clinician who is encouraged to study disease both in its immediate and remote effects. The subject has also intimate relations with therapeutics. The deeper the insight into the problems of disease the clearer the vision that adapts remedy to disorder. Attention will be directed to the influence of reactions on their cause, a most important subject that hitherto has been singularly neglected.

This Volume is mainly devoted to Vicious Circles in human pathology ; only brief reference is made to the same process as complicating diseases of the lower animals or of plants. But an enquiry into the latter will yield some important results well worthy of the labour. Fresh light will be thrown on the problems of pathology and of rational therapeutics. A special emphasis is laid on the necessity of "breaking the Circle" in order to secure recovery, and instances are given to shew how Circles may be broken both by Nature and by Art.

The conception of the Vicious Circle is very ancient. Asclepiades (ca. 124 B.C.) probably referred to it when he opposed the Hippocratic "Nature is the healer of disease" by the dictum "Not only is Nature useless, but it is sometimes harmful." Galen (ca. 130 A.D.) gives the following illustration of the morbid process :

Τὰ κατὰ πνεύμονα τῶν ἐλκῶν δυσιατότατα· χωρὶς μὲν γὰρ τοῦ βήττειν οὐκ ἂν ἐκκαρθαρθεῖη, βηττόντων δ' ἐπιρῆγνυται. εἰ ἀλλήλων οὖν αὐτοῖς κυκλεῖται τὸ κακόν.

"Ulcers of the lung are most difficult to heal; for they cannot be cleansed apart from coughing, and by coughing they are torn further. Thus owing, so to speak, to a reciprocity of action, the disorder revolves in a circle."<sup>1</sup>

The subject as a whole deals with conditions in which Nature's attempt to cure reflects small credit on her provisions, and the study will be found full of suggestion and guidance for the philosophic physician. Illustrations are so helpful in visualizing ideas that it has been thought well to introduce a considerable number. Especially may they be commended to teachers :

*Segnius irritant animos demissa per aurem  
Quam quae sunt oculis subjecta fidelibus.*



<sup>1</sup> Galen, Methodus Medendi, V. 11., (Kühn's ed. X., p. 360). The following is the Latin version : "Ulcera pulmonis difficillime sanantur, ut quae nec citra tussim expurgare possis, et si tussim excites, laceraveris. Itaque quasi per mutuas operas malum iis in orbem redit." Cf. also Neuburger, History of Medicine, I., p. 204.



# Chapter One

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## THE AETIOLOGY OF VICIOUS CIRCLES



THE Vicious Circle is a morbid process to which all organised animals and plants are liable. This phenomenon is associated with differentiation of structure and function, and illustrates a great physiological law applicable to all but the lowest living things.

Throughout life there is a constant process of reciprocation taking place between the various organs and functions both in animals and in plants. In animals the nervous, the cardio-vascular, the respiratory, the digestive and other systems are intimately associated with each other, their functional activities being harmonised by the all-controlling nervous system, increased or diminished requirements in one direction being balanced by the necessary adjustments in another. Moreover a circulating fluid supplies to each organ the kind and quantity of nutriment required, while the waste products that would clog further activity are removed.

The corresponding correlations as seen in plants are less obvious than they are in animals. There is neither an all-controlling central nervous system, nor a circulating nutrient fluid at all comparable with the blood. Nevertheless in principle the phenomena of correlation are the same, and are controlled by stimuli connecting every part of the organism. This applies to the shoots, leaves, cortex, cambium, roots, in fact to every organised structure of the plant, although the inter-dependences are more

obvious in some cases than in others. In brief, both in animals and plants the vital mechanism is carried on by means of an ever-acting chain of complex interactions.<sup>1</sup>

Even within the limits of health there are frequent disturbances of the harmonious co-operation between various organs. These, however, induce reactions which restore the natural state of equilibrium. Only when the disturbance is so severe that rapid restoration is impossible does the condition become pathological.

In disease the physiological correlations are thrown into confusion. Disorder in one organ frequently awakens disorder in other associated organs which in turn react injuriously on the first, so that a circular sequence of pathological reactions is established. Doubtless to some extent organs can give vicarious assistance to one another in difficulty and when the disturbance is only slight this relief may be sufficient to allow of recovery.

But such assistance is of limited potency, at any rate in animals whose organs are worked nearly up to their maximum capacity. In plants, on the other hand, there is greater opportunity for vicarious activity, since there is less specialisation of structure, and there is always the possibility of developing

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<sup>1</sup> With the progress of our knowledge of cellular physiology and pathology it may be possible to pursue the process of the Vicious Circle into the mechanism of the individual cell, which forms the basis of all vital processes. In unicellular organisms all functions are carried out in the one cell; but special adaptations are so microscopic as to be indistinguishable in detail. We do not know whether an elaborate differentiation exists in the cell, or whether the cell taken as a whole is able to act like the complex apparatus of a higher plant or animal which may consist of millions of cells.

fresh organs such as roots, shoots, leaves, flowers etc.

In both animals and plants, moreover, vicarious assistance often has unfortunate effects, since by it a second organ or set of organs is in turn involved in difficulties, over-taxed and perhaps deranged by the unusual demands made upon it. In the words of Mitchell Bruce "vicarious help ends in a Vicious Circle."

In the case of the animal the process may be illustrated by cardiac disease which affects the nervous, the respiratory, the digestive and other systems sympathetically, while these secondary disorders in their turn injure the organ primarily affected. Thus is the *circulus vitiosus* established.

In the diseased plant similar injurious interdependences are observed. A common illustration is afforded by root starvation, leading to an inadequate supply of nutritive material to the assimilating leaves. Their metabolic activity is impaired and such impairment reacts injuriously on all other organs. The formation of vessels in the xylem is checked. The sieve or phloem tissues are less able to transport products of assimilation to the roots. Further root starvation takes place and the sequence of events is repeated.

A similar concatenation of injurious factors may start from any other organ. If the leaves of a plant are so feebly illuminated that assimilation is reduced to a minimum, the results are far-reaching. The stem remains thin; the growth of the cambium layer is arrested; the supplies of nutriment passing to the roots are insufficient for their growth and for the formation of new root-hairs. Absorption of water and salts is interfered with, and this in turn further paralyses the formation of chlorophyll and the process of photo-assimilation. Here also is established a mutual causal relation between disease of various organs.

There is, however, a striking difference in the manifestation of the morbid process in animals and in plants.

In animals, owing to the higher differentiation of organs, numerous specific *circuli vitiosi* are met with, and additional examples are constantly being discovered. Thus disease of the blood provokes disease in other tissues, which in their turn pour products of perverted activity into the blood, and it is possible to study this endless chain of disorder link by link.

Future research may yield similar results in plant pathology. But at present specific effects of morbid reactions are but little understood. On the other hand the general principle is in universal operation, manifesting itself not by specific results but by the production of lowered resistance to morbid agencies, and playing a part of great importance in the growth and life-history of the plant. For example, lowered resistance permits parasitic invasion and this in turn further weakens resistance. The lower the resistance the more rapid is the progress of the parasite, while, on the other hand, the rapid progress further lessens resisting power.

The several organs and functions in animals and plants vary in the power of resisting morbid influences. This varying liability depends on numerous factors, such as heredity, age, environment, nutrition and so forth. Hence it is that injurious circular reactions are more often observed in some organs than in others, at some periods of life than at others. Certain Vicious Circles are prevalent in youth, others in advanced life. Some organs succumb readily to malnutrition, others to fungus or bacterial invasion. There is indeed an infinite variety in the influence exerted by pathogenic factors and in the response made by the living organism and its tissues.

Other Vicious Circles result from the reciprocal

reaction on each other of a disorder and its symptoms. Of such a process numerous illustrations will be described in the following pages. They are especially common in neurasthenia. For example, some neuropaths suffer from insomnia which in its turn perpetuates the neurosis. Others may be tormented by auto-suggested cardiac disorder which further depreciates their reserve stock of energy, and so forth.

Lewandowsky thus refers to this group of circular reactions :

“ A highly injurious Vicious Circle is formed as a result of the increased irritability due to exaggerated functional activity in neurasthenia.<sup>1</sup>

The two great causes of the morbid process discussed in this Volume may then be summed up as disturbed correlations between organs or parts of organs, and secondly the injurious reaction of symptoms on the primary disorder. These processes constitute a large part of the mechanism of disease.

There is probably no disease either in animals or plants in which all the reactions provoked by the morbid factors are either beneficent or maleficent. Both tendencies are simultaneously in operation and the result of the disease depends on the relative potency of those beneficent and maleficent reactions. Happily in the great majority of cases the beneficent reactions prevail and the injurious ones are insignificant in their action or wholly obscured in their manifestation. Where, however, the maleficent reactions are dominant the Vicious Circle comes into operation, leading to a perpetuation or aggravation of the morbid process or possibly death. Under yet other circumstances there may be something like “ an equation of counteracting processes ” so that the diseased organism remains in an approximately stationary condition, the forces tending to

<sup>1</sup> Handbuch der Neurologie, V. (iv.), p. 610.



recovery being neutralised by opposite forces. Time must be given to allow of reparative processes to exert their influence and perchance gain the upper hand. As Clifford Allbutt puts it : " Such a Vicious Circle may be established that . . . . if recovery is to take place, the tension between the opposing forces must be released—the deadlock must be overcome—even if some considerable oscillation in the direction of danger have to be reckoned with."<sup>1</sup>

Such then appears to be the pathological basis of the *circuli vitiosi* met with in animal and plant diseases. This Volume, however, is mainly concerned with this morbid process as met with in human pathology, and we may now pass on to discuss this narrower operation of a general principle.



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<sup>1</sup>*Clinical Journal*, III., p. 194.

## Chapter Two

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### THE CLASSIFICATION OF VICIOUS CIRCLES



IN the Chapter dealing with *Ætiology* the origin of Vicious Circles was attributed to a disturbance of the physiological interdependence of organs and tissues. That disturbance may shew itself in a great variety of disorders. These will be considered in connection with the various systems of the body, thus following the usual classification adopted in works on medicine. This arrangement is, however, based rather on convenience than on principle, since many injurious circular reactions are not confined to a single system, but reverberate far and wide ; in such cases there may be a doubt under which system they may most appropriately be grouped.

Another classification is one based on the number of the circular reactions provoked by a given disorder. The injurious sequence may be limited to a single reaction on which treatment can therefore be concentrated. On the other hand there may be multiple concurrent reactions, the effects of which on the primary disorder are cumulative and consequently far more difficult to arrest. Examples of such concurrent Vicious Circles are shewn in **Plate I. a, b**, where cardiac failure and pulmonary tuberculosis are shewn to be thus complicated. It would have been easy to indicate an even larger number of concurrent reactions in each of these disorders ; but those described will suffice to illustrate the principle.

Some Vicious Circles are specific in their influence, others are non-specific. In the former case the primary disorder provokes a definite local reaction in some organ or organs which aggravates the original disorder ; in the latter the primary disorder merely lowers the power of resistance, which lowering perpetuates and intensifies the original condition. The first group is abundantly illustrated in diseases of man and the lower animals, while the non-specific forms are widely prevalent in the vegetable kingdom.

Another classification might be based on the predominance of some special factor. Thus we might distinguish between organic, mechanical, infective, chemical or neurotic Vicious Circles, and numerous illustrations of each of these forms will be found in the following pages.

A distinction may also be drawn between Circles which arise in the natural course of disease and those which are artefacts, i.e. dependent on social customs or injudicious treatment. It will be sufficient in this place merely to indicate such an aspect of the subject which will be discussed in a special Chapter.

The number of component factors completing a circular reaction varies considerably. Two is, of course, the minimum, but some writers have split up the morbid sequence into as many as eight or ten different components.<sup>1</sup>

Classifications, although useful in clarifying ideas, are after all of secondary importance. Each reader will adopt the system most helpful to himself.

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<sup>1</sup> Halls Dally (*Medical Press*, 1913, I., p. 222) illustrates a cardio-gastric Vicious Circle comprising ten factors ; Pickerill (*The Prevention of Dental Caries and Oral Sepsis*, p. 299) one comprising six factors.

# Chapter Three

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## THE NERVOUS SYSTEM



THE central nervous system is the capital of the human microcosm with whose remotest outposts the capital is, for good as well as for ill, in constant communication. In health the closest correlations and polarities exist between it and every other organ; in disease such correlations and polarities are no less intimate.

The injurious circular reactions met with in disorders of the nervous system are very numerous; fresh illustrations are continually being revealed by the progress of research. All that can be attempted here is the description of some striking examples, which every practitioner will be able to supplement from his own experience.

We shall deal in order with

- I. Functional Diseases
- II. Organic Diseases

### I. FUNCTIONAL DISEASES

#### (A) NEURASTHENIA

The commonest and most protean of functional disorders is neurasthenia. "In no complaint does it happen more frequently that the patient gets into a Vicious Circle, the fundamental disorder producing symptoms which again maintain and

aggravate the disease."<sup>1</sup> Owing to the infinite variety of its manifestations neurasthenia has been described as *non morbus, sed morborum cohors*, and in truth there is scarcely an organ or function that may not at one time or another be affected. In this disease self-aggravating factors are constantly present, whether the psychical or physical functions are involved.<sup>2</sup>

This characteristic of neurasthenic disorders is doubtless due to the lowering of the neuron threshold, owing to which an increased response follows a given stimulus. In other words such a stimulus acts more readily and more vigorously in a neurasthenic than in a normal individual, and the result is a further lowering of the threshold.

It will be convenient to deal first with psychical and then with physical disorders, although much overlapping is inevitable.

#### (a) Psychical Disorders

Neurasthenia is frequently associated with perverted emotivity and ideation (**Plate II. a**). These perversions vary greatly in their manifestations. The following examples may be briefly referred to: irritability, anxiety, melancholia, insomnia.<sup>3</sup>

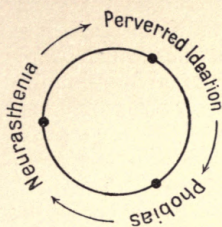
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<sup>1</sup> Ballet, *Neurasthenia*. Introduction by Campbell Smith, p. xxvi.

<sup>2</sup> Fuller particulars will be found in a volume entitled *The Vicious Circles of Neurasthenia and their Treatment*, by J.B.H.

<sup>3</sup> The psychical state in which the individual is governed by ideas or emotions, which more or less persistently obtrude themselves on consciousness, is frequently termed psychasthenia. But there is no definite border-line separating such psychical from physical manifestations, and the condition will here be included under the term neurasthenia.

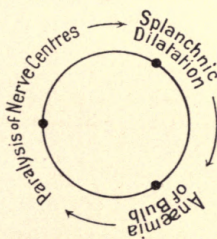




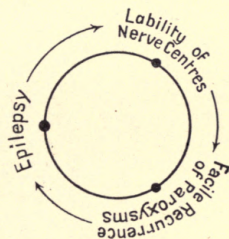
(a) NEURASTHENIA



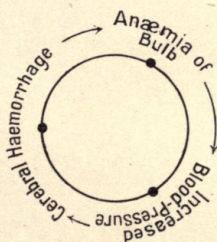
(b) HYSTERIA



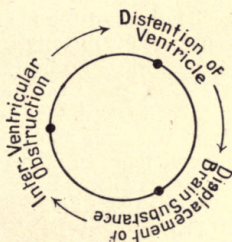
(c) SHOCK



(d) EPILEPSY



(e) APOPLEXY



(f) HYDROCEPHALUS

**Plate II.—Circles associated with the Nervous System.**

**Irritability.** One of the commonest symptoms of neurasthenia is an exaggerated irritability, with a tendency to worry about trifles which would not disturb the equanimity of a normal individual. Such irritability may be either intellectual or emotional, but in either case there is a drain on the store of nervous energy so that the condition feeds itself. In some persons there are unreasonable explosions of ill-temper, a morbid sensitiveness to the opinion of others, an exaggerated conscientiousness and so on. Indeed the symptoms are infinite in variety and degree, doubtless also in the tax they levy on the reserve resources, and in the exhaustion they cause of the nerve centres.

**Anxiety.** A form of irritability which deserves special mention reveals itself by various forms of undue anxiety and by the presence of phobias which haunt the victim and depress his vitality. Every phobia, associated as it is with loss of self-control and with auto-suggestions, intensifies its own cause.

Dubois describes the condition :

“ In neurasthenia one must take into account the real fatigue of the nervous centres which, on the one hand, results directly from morbid states of mind, and, on the other, furnishes new food for auto-suggestions. Here we have the eternal Vicious Circle in which the neuroses travel. Their real ills give birth to their fears and their phobias, and, on the other hand, their mental representations of a pessimistic nature create new disorders.”<sup>1</sup>

Spear also writes :

“ The mental state of the individual suffering from neurasthenia is also very important—these individuals are usually depressed, introspective, anxious, apprehensive ; mental rest is therefore very difficult to

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<sup>1</sup> *Psychic Treatment of Nervous Disorders*, p. 180.

obtain. As the unconscious mental activity is just as exhausting as, if not more so, than conscious and physical unrest, a Vicious Circle is established whereby the nervous system is maintained in a state of exhaustion. It is the presence of this Vicious Circle that renders the establishment of a state of complete rest so difficult and consequently makes the cure of this condition doubtful and sometimes impossible.<sup>1</sup>

These anxiety neuroses are closely associated with loss of will-power. Every effort may be made to exert and coax the will, yet the result may be utter failure and the greater the effort the less the success. Indeed the very attempt to will may annihilate will-power.<sup>2</sup> Volition can also be readily exhausted by the imagination, and the process once started continually reinforces itself.

Phobias are by no means confined to waking hours. In some forms of neurasthenia, brought on by war conditions, terrifying dreams have been a prominent symptom, associated with a low blood-pressure and perpetuating the exhaustion of the neurons.<sup>3</sup> Night terrors in children supply a further illustration.

**Melancholia.** In other cases neurasthenia shows itself by profound melancholia. There is inveterate pessimism, and the depression further diminishes the already reduced nervous capital. Sufferers frequently display a tendency to continual introspection, to an exaggeration of slight disappointments, and the more they brood over troubles the worse these appear, in harmony with the well-known psychological law that attention intensifies sensations.

This form of neurasthenia may be acquired as a

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<sup>1</sup> A Manual of Nervous Diseases, pp. 495, 505.

<sup>2</sup> Dowse, Neurasthenia, pp. 28, 30.

<sup>3</sup> *Lancet*, 1917, II., p. 456.

result of shock or accident, especially if litigation is probable. The trauma may appear to be insignificant, and yet the resulting neurosis completely transforms the outlook on life owing to the deep mental impression made by the shock. In some cases mischief is done through the interaction between the mind of the patient and that of his physician or solicitor, i.e. through hetero-suggestion.

Thorburn writes :

“The patient has often heard that after the shock of, let us say, a railway accident, symptoms are liable to be progressive, to develop at remote periods and to endure indefinitely. In this condition of expectation of disaster he consults probably both his medical and his legal advisers. The former has often a limited experience of traumatic neuroses ; he knows that his patient is and always has been an honest man ; he may have doubts in his own mind as to whether organic disease of the nervous system does not follow shock. In any event, he enters upon his task of relief and encouragement with a more serious aspect than he would otherwise assume, he takes careful note of all minor symptoms, and he probably has to write reports to the solicitor, which he is asked to make ‘as strong as possible.’ The solicitor is an even graver danger ; it is his professional duty to obtain the largest possible amount of compensation for his client, and in so doing to emphasize to the utmost any loss, inconvenience or suffering which the latter may have sustained, and especially to guard against the making of any settlement before all possible future inconveniences have been excluded. None of the people thus concerned have any intention to exaggerate, but each mind reacts upon the other, and we have established a complete Vicious Circle as a result of which the unfortunate patient tends to grow daily worse.”<sup>1</sup>

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<sup>1</sup> *Proc. Royal S. of Med.* (1914), VII. (ii.), (*Neurological Section*), p. 8. Cf. also Bailey, *Diseases of the Nervous System in Cases of Accident*, p. 434.



**Insomnia.** Insomnia frequently complicates neurasthenia and is, in Clifford Allbutt's words, "generally one of the links in the Vicious Circle in which the victim is enchained."<sup>1</sup> Such sleeplessness results from over-excitability of the cerebral cortex, from a lowering of the neuron threshold which enables stimuli, which would be subliminal in normal individuals, to affect consciousness. Insomnia in its turn prevents the renewal of those substances which are used up by the discharge of energy and thus perpetuates itself. Again conditions which interfere with the repose of those brain cells which are the organs of conscious thought may keep in operation the processes of ideation, with which is necessarily associated some cerebral hyperæmia. Ideation and hyperæmia then react one on the other and form a sequence of events that torments the neuropath.<sup>2</sup>

Insomnia may also be due to excessive fatigue, to an exhaustion of the nerve centres which arrests the progress of repair. Such a condition is readily provoked in neurasthenics owing to their lower reserves of potential energy. The insomnia hinders recuperation and acts as a malignant abettor.<sup>3</sup> Habitual sleeplessness is not uncommonly due to the cerebral neurons or vessels failing to resume their rhythmical quiescence at bed-time. The more the sufferer tries to sleep the less his success. Insomnia and the dread of it react upon and aggravate each other. Job evidently was a bad sleeper :

"When I lie down I say ; When shall I arise and the night be gone ? And I am full of tossings to and fro unto the dawning of the day."<sup>4</sup>

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<sup>1</sup> Allbutt and Rolleston, *System of Medicine*, VIII., p. 750.

<sup>2</sup> Sawyer, *Insomnia, its Cause and Cure*, pp. 26, 27. Cf. also Saleeby, *Worry, the Disease of the Age*, *passim*.

<sup>3</sup> Garrett Anderson, *Encyclopedia Medica*, VIII., p. 336.

<sup>4</sup> Ch. VII., 4.



In many cases an accumulation of toxins may be both cause and effect of the sleeplessness.

Amongst other psychical manifestations may be mentioned vertigo,<sup>1</sup> anorexia, and an exaggerated proclivity to the repression of painful memories.<sup>2</sup> All of these may perpetuate the neurosis.

Several forms of psychical disorder are usually present simultaneously and the mischievous influence is then cumulative. In severe cases all the above-mentioned disorders may combine to reduce the sufferer to the direst misery.

### (b) Physical Disorders

In most cases of neurasthenia local symptoms are present which feed the neurosis and perpetuate the disorder. Owing to the lowered neuron threshold peripheral impulses which would not affect consciousness in health evoke uncomfortable or even painful sensations. These disturb ideation and emotivity and arouse injurious auto-suggestions. The direction of consciousness aggravates the trouble, since attention intensifies sensation.

This general principle is thus stated by Krafft-Ebing :

"A true Vicious Circle is gradually developed in neurasthenia, in consequence of the morbid relations between the psychic and the somatic functions. A crowd of functional disorders are projected by the psychic condition into the extracephalic organs, and these in their turn react on the psychic condition, more especially on the emotions."<sup>3</sup>

<sup>1</sup> Bing, Text-Book of Nervous Diseases, p. 411.

<sup>2</sup> Rivers, The Repression of War Experience, *Lancet*, 1918, I., p. 173.

<sup>3</sup> Nothnagel, *Specielle Pathologie und Therapie*, Nervosität und Neurasthenische Zustände, p. 71. Cf. also Babinski and Froment, *Hysteria or Pithiatism*, p. 65.

These physical or somatic disorders present a great variety in form and severity ; but as a rule the sufferer tends to magnify a molehill into a mountain and adheres obstinately to his erroneous perspective.

It is not necessary to discuss these local disorders in any great detail since this has already been attempted in another volume ;<sup>1</sup> but the picture would be incomplete without some reference to the more important local reactions. These are not, as a rule, limited by hard and fast lines. The interlocking gears are so complex that disorder awakens echoes in all directions with endless secondary reverberations. The following examples must merely be regarded as typical of many others.

**Cardiac Neuroses.** No functional disorders arouse greater anxiety than those connected with the heart. Even when trivial in themselves they may arouse a confident belief in a speedy exitus. Imaginary heart disease is said to be even commoner than organic heart disease, and supplies a good illustration of how the dread of a disease may provoke corresponding subjective sensations.

The sequence of events is somewhat as follows : the fear of heart disease awakens auto-suggested sensations in the cardiac region producing tachycardia, extra-systoles with palpitation, and an intermittent pulse. The associated sensations then arouse distress and terror, which in their turn further disturb the cardiac action.

Such attacks are especially common at night and may be caused by nightmare, reducing the neurasthenic person to a condition of utter misery. Even fatal syncope may result.

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<sup>1</sup>The Vicious Circles of Neurasthenia and their Treatment,  
by J.B.H.

André-Thomas describes the condition :

"Not only may neurasthenia give rise to cardiac disorders and anxieties, but cardiac anxieties may also give rise to neurasthenia. . . . Emotions, kept alive by fear, aggravate the symptoms or create fresh ones. Thus the patient becomes involved in a Vicious Circle which persists until he can be convinced that there is nothing amiss with his heart."<sup>1</sup>

Dubois draws attention to the same correlations and points out that the expression "spiral" is in many respects preferable to "circle," since it more clearly conveys the idea of an ingravescent condition :

"The patient may attribute the beginning of his illness to some psychic disorder, such as an imaginary evil that worries and frightens him. Or, conversely, he may attribute his trouble to some emotion due to his local disorder. In either case his illness works in a Vicious Circle or rather in a spiral. The local trouble that bothers him arouses hypochondriacal ideas and causes distress, followed by palpitation and gastrointestinal dyspepsia which in their turn create phobias. These fresh disturbances then provoke other functional disorders or aggravate the existing ones. Hence a fresh source of phobias which drive the victim further along the spiral."<sup>2</sup>

Cardiopaths are frequently met with in whom the erroneous belief that they have heart disease excites an ever-present dread of illness or immediate death. The constant direction of the mind to the imaginary lesion then leads to a morbid consciousness of trivial sensations and to such an unwholesome régime as actually to make the heart feeble and flabby, so

<sup>1</sup> *Psychothérapie*, pp. 229, 230. Cf. also Lewandowsky, *Handbuch der Neurologie*, V. (iv.), p. 40. *Clinical Lectures by German Authors (N.S.S.)*, (1894), p. 69. *Practitioner*, 1918, I., pp. 179, 186, 188.

<sup>2</sup> Volkmann, *Sammlung Klinischer Vorträge (Innere Medizin)*, Nos. 137-166), 1907-1909, p. 520.

that at the slightest provocation it reacts on the neurotic condition. The exaggerated fears, like the sword of Damocles, over-shadow life and render all enjoyment impossible. Such obsessions are amongst the commonest complications of neurasthenia.

Mott thus describes them :

"Any organ or structure which naturally or by habit performs its functions automatically becomes disordered in its functions when there is mental apprehension and preoccupation regarding the performance of that function. Hence we can understand how a continued preoccupation regarding the function of an organ like the heart or stomach, or indeed any organ of the body, of the perfect action of which we should be quite unconscious, becomes an obsession, for disordered function tends to repercussion in the field of consciousness, causing a continual conflict between reason and emotion for re-adjustment. Thus a Vicious Circle is liable to be established owing to the inherent state of emotivity of the neurasthenic."<sup>1</sup>

Other cardiac neuroses are described on p. 53.

**Gastric Neuroses.** The correlations existing between the nervous and the digestive systems are so intimate that disorder in the one readily provokes disorder in the other. Their importance has been emphasised by Mathieu and Roux :

"There is in these cases an interlocking system of Vicious Circles with which the physician must be familiar if he wishes to understand the mechanism of the diseased organism, and if he wishes his treatment to be rational and useful."<sup>2</sup>

Since the various regions of the gastro-intestinal

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<sup>1</sup> *Lancet*, 1918, I., p. 128.

<sup>2</sup> "Les Cercles Vicieux dans la Pathologie Gastro-Intestinale," *Pathologie Gastro-Intestinale*. Series I. (1909), p. 147.

tract have been discussed in detail in another volume, we may content ourselves with three examples.

Atonic dyspepsia is one of the commonest physical disorders in the neuropath, cause and effect abetting each other.

Cramer writes :

"Not only do the nervous disorders provoke neurotic dyspepsia, but in its turn the neurotic dyspepsia intensifies the nervous disorder."<sup>1</sup>

Auto-suggestions are also very prevalent and may play almost as great a part as in cardiac neuroses. Ceaseless preoccupation with the state of the stomach brings gloom and discouragement which perpetuate the hypochondriasis.

Membranous colitis is another disorder in which the local and central conditions reciprocally maintain each other.

Mathieu writes :

"In cases of muco-membranous colitis . . . a true Vicious Circle appears often to be present. The neurasthenia and the colitis react on and aggravate each other."<sup>2</sup>

And again :

"The colitis, the pain and the nutritive disorders create and perpetuate the neurasthenia. The neurasthenia in its turn aggravates the colitis. A Vicious Circle is present."

A third example is presented by constipation, frequently both effect and cause of neurasthenia. The exhaustion of the nervous system shows itself in sluggish peristalsis, and the resulting coprostasis in its turn depreciates the functions of the nervous system.

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<sup>1</sup> Nervosität, p. 197. Cf. also Saleeby, *Worry, the Disease of the Age*, p. 130.

<sup>2</sup> *Traité des Maladies de l'Estomac et de l'Intestin*, pp. 288, 304.



Strümpell writes :

“ Habitual constipation is frequently associated with neurasthenia, but the nature of this association is probably not the same in every case. Often neurasthenia and constipation seem to be co-ordinate symptoms ; sometimes existing constipation has an unfavourable effect upon the psychical condition of patients, rendering them feeble, fretful, out of sorts and nervous. As a rule, however, neurasthenia is the primary disease, and the irregularity of the bowels appears as a result of abnormal nervous influences or secondary conditions. Often the two states act in a Vicious Circle, each sustaining and aggravating the other.”<sup>1</sup>

In other cases of neurosis there may be hyperperistalsis and diarrhœa, which in turn keep up a state of obsession. The more the neuropath dreads an attack of diarrhœa the more likely is it to occur, and *vice versa*.

Gant writes :

“ Stimuli responsible for diarrhœa may be induced by psychic emotions, disease of the brain, cord, general or local nerve mechanism, inflammation, ulceration, neoplasms, strictures of foreign bodies in the intestine, or lesions affecting it from without, or anything which irritates the intestinal nerve-ganglia.

Occasionally, multiple or widely varying stimuli work simultaneously, so that a Vicious Circle is established, under which circumstances there is exaggerated intestinal motility, and the patient suffers deplorably from diarrhœa extremely difficult to relieve or cure.”<sup>2</sup>

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<sup>1</sup>Text-Book of Medicine, I., p. 611. Cf. also The Vicious Circles of Habitual Constipation, by J.B.H., *Practitioner*, 1915, II., p. 560.

<sup>2</sup>Diarrheal, Inflammatory, Obstructive and Parasitic Diseases, p. 18. Cf. also Matthieu and Roux, *Pathologie Gastro-Intestinale*, Series III. (1911), pp. 208, 230.

**Sexual Neuroses.** There are numerous circular reactions between the nervous and the sexual systems, primary and secondary factors reinforcing each other. This applies to the entire sexual tract, every region of which is closely linked with the central nerve centres. The weakening of self-control so common in neurasthenia only too often leads to excessive self-indulgence which intensifies the weakness. Inmates of lunatic asylums often present lamentable results of such indulgence which is often incurable, especially where there are inherited neuropathic tendencies.

Müller writes :

“In neurasthenic persons of both sexes, especially if unmarried, there is a tendency to satisfy the sexual instinct by means of masturbation. Indeed it is often difficult to decide whether the masturbation should be regarded as a result or as a cause of the sexual neurasthenia, since a Vicious Circle has generally been established.”<sup>1</sup>

Again in sensitive, highly strung women, morbid correlations are frequently set up by uterine or ovarian congestion or pain. The nervous system and the local disorders act and react on each other.

As Amand Routh says :

“We have frequently to deal with a Vicious Circle, with local and constitutional states so interacting that no real improvement is possible until both the general and local states receive their due share of attention.”<sup>2</sup>

Herman and Maxwell also write :

“In chronic pelvic pain with neurasthenia effects follow one another in a Vicious Circle. The patient feels more severely the pelvic pain because her nervous system is too sensitive. The persistent pelvic pain

<sup>1</sup> Neurasthenie, p. 181. Cf. also Hühner, Diseases of the Sexual Function, pp. 4, 15, 161, 183.

<sup>2</sup> Allbutt, Playfair and Eden, Gynæcology, p. 737.

keeps her nervous system weak and sensitive and further weakens it.”<sup>1</sup>

Such uterine and ovarian pain is a good illustration of the general relation of pain to a hyperæsthesia of the nervous system. Each factor intensifies the other and the process has much to do with the invalidism so often met with in highly-strung women. If sleeplessness is superadded the symptom-complex is even more difficult to deal with.

The same inter-dependences apply *mutatis mutandis* to neuralgia and nervous headache.

Herman has well described the condition :

“The great causes of neurasthenia are conditions which (a) cause continuous pain and (b) prevent sleep. The two things often form a Vicious Circle. A small local cause disturbs sleep, and want of sleep makes the nervous system over-sensitive. In proportion as the neurasthenic symptoms have coincided in time with the development of local pain, so surely may we conclude that the removal of the local pain and the procuring of sound sleep will cure the neurasthenia.”<sup>2</sup>

Many other illustrations of somatic neuroses might be given, did space permit ; but enough has been said to indicate the facile creation of Circles where the neuron threshold has been lowered in neurasthenia. Such reciprocal correlations indeed play a great part in the psychology of modern life.

## (B) OTHER FUNCTIONAL DISORDERS

**Hysteria.** Hysteria differs mainly from neurasthenia by the presence of an abnormal mentality which shows itself in increased suggestibility and emotional instability, combined with lowered powers of inhibition. In many cases some disappointment or other source of psychical distress has been repressed

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<sup>1</sup> Diseases of Women, p. 73.

<sup>2</sup> *British Med. J.*, 1910, I., p. 183.

and disappears from consciousness. Yet the repressed ideas remain latent and may break out in some form of mental or physical reaction which perpetuates the primary instability.<sup>1</sup>

A striking disorder which is not uncommon in hysterical women is that known as anorexia nervosa to which attention was drawn by Gull and Weir Mitchell (**Plate II. b**). The condition may originate in some perversion of appetite or in a fear of growing fat or in some minor ailment which suggests the idea of illness and an inability to take food.<sup>2</sup> This is accompanied by an actual loss of appetite or even a refusal to be tempted to eat, and results in general emaciation. The neurosis tends to starvation; the starvation feeds the neurosis. The nervous system is profoundly affected, the blood is impoverished and the psychical functions disordered. As a result the sufferer becomes a bed-ridden querulous invalid, a burden to her family. In course of time the malnutrition reduces the body to a bag of little more than skin and bones, and a fatal issue often closes the scene.

Schofield writes as follows :

“ A Vicious Circle is often kept up in these cases which it is absolutely essential to break. They begin, it may be, with loss of appetite from some slight cause. This . . . leads to disordered thoughts and the idea of disease is started. This, again, makes the appetite still more capricious ; the thoughts therefore get still worse, and so the body starves the brain and the brain

<sup>1</sup> Spear, Manual of Nervous Diseases, p. 472.

<sup>2</sup> The opposite conditions to those described in this Section establish physiological or virtuous Circles—*circuli virtuos*i—of which a large number are in constant operation in the normal body. Good nutrition, sleep, exercise, cheerfulness of disposition are all closely dependent on each other.

starves the body ; and the emaciated patient having, probably enough, first worn out her friends, sinks at last into her grave from sheer starvation. I have seen such deaths.”<sup>1</sup>

Rayner has also described the process :

“ In diseased conditions, especially in the depressed emotional states, this interaction of the mind on the body and of the bodily state on the brain establishes a Vicious Cycle of nutritional disorder, which tends to increase and prolong the disease.”<sup>2</sup>

**Migraine.** The pathology of the functional disorder known as migraine or hemicrania is still obscure, some neurologists attributing it to a form of nerve-storm, others to a spasm or relaxation of the smaller arteries or veins, others to toxæmia, others to increased pressure in the ventricles of the brain, associated with stenosis of the foramen of Monro.

If the latter hypothesis is correct, a self-perpetuating condition is probably present which is thus described by Jelliffe :

“ The occasional causing of a passive or active hyperæmia of the brain leads to hyperæmia of the choroid plexus. This causes a more or less complete plugging of the foramen of Monro, with increase of pressure in one or both of the ventricles. The increased pressure on the vessels causes more distention and more pressure on the walls of the ventricles ; a Vicious Cycle established and the migraine mounts to its height, until the pressure is relieved, either by a spontaneous reduction or by the sudden let-down in tension due to

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<sup>1</sup> Nerves in Disorder, p. 162.

<sup>2</sup> Allbutt and Rolleston, System of Medicine, VIII., p. 965. Dr. Rayner and other writers substitute “ Vicious Cycle ” for “ Vicious Circle.” The latter term seems preferable as implying continuity as opposed to recurrence.



a shock reaction—such as occurs in the act of vomiting, from the use of various vaso-dilators, etc.”<sup>1</sup>

On the other hand Adami believes the cause to lie in a paradoxical contraction of arteries which also creates a circular reaction.

Adami writes :

“ The higher the blood pressure, the greater becomes the contraction of the arterioles ; the less, therefore, the blood supply to the tissues and the greater the call upon the central nervous system for more blood. Whether from reflex stimulation of the heart to increased activity in order to supply the tissues, or from direct automatic action of the increased aortic pressure in raising the intraventricular pressure, and so stimulating the ventricles to more forcible contraction, the blood pressure becomes yet higher, and, as a result, the arteries still further contracted. It is along these lines that we would explain the progressive rise of blood pressure and contraction of the smaller arteries in migraine.”<sup>2</sup>

Further research is necessary before the pathology can be regarded as settled.

**Shock.** Under this term may be included various conditions such as fainting or syncope in which there is loss of vaso-motor control (**Plate II. c**). There may be a variety of causes including the administration of an anæsthetic, concussion, strong emotion, hæmorrhage etc. During health the activity of the vaso-motor centres is increased or diminished, according as arterial pressure falls or rises, the cerebral circulation being maintained by this compensatory mechanism. But when this centre is paralysed, exhausted or inhibited by fear or other cause, the vaso-motor mechanism is thrown out of

<sup>1</sup> Osler and Macrae, *System of Medicine*, V., p. 710. Cf. also Spitzner, *Ueber Migraine*, p. 76.

<sup>2</sup> *Principles of Pathology*, II., p. 175.

gear, and is weakened instead of stimulated by a diminished blood-supply. In severe cases the blood-pressure falls so much as partially to empty the intrinsic cardiac and cerebral vessels. Less blood is pumped up to the brain, and the bulbar centre is still further weakened.<sup>1</sup> The cardiac anæmia may also cause enfeeblement and dilation of the heart, and thus further interfere with the compensatory mechanism. Attacks of fainting are due to a like interference with the vaso-motor mechanism. Every faint renders the bulbar centres which are largely controlled by self-consciousness more liable to loss of control over blood-pressure.

**Paroxysmal Neuroses.** Rhythm plays a part of great importance in physiological processes, as is shown by the periodicity in the functions of the heart, the lungs, the intestines, the ovaries, the brain and so forth. There is economy of energy in such a mechanism since one stimulus does the work of many.<sup>2</sup>

Such a fundamental biological principle finds corresponding expression in pathology, as may be illustrated by various paroxysmal neuroses. In such there is often an increasing proclivity to paroxysm which may be acquired through mere repetition. Each attack from being at first an effect

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<sup>1</sup>Crile, *British Med. J.*, 1910, II., p. 759. Cf. also *Practitioner*, 1910, II., p. 169. Although this explanation is the one usually accepted, pathologists doubt its sufficiency, since the vaso-motor centre is by no means always exhausted in shock, and the general and visceral arteries may be found contracted instead of dilated. The question is still *sub judice*. *British J. of Surgery*, I., p. 114.

<sup>2</sup>An excellent account of rhythm in biology is given by Gilford, *Disorders of Post-Natal Growth and Development*, pp. 112, 123.

becomes in turn a cause. Epilepsy supplies a good example (**Plate II. d**). Every fit increases the labile condition of the nerve centres and facilitates recurrence. Hence the best treatment is to break the habit.

The rhythm associated with the status epilepticus may establish other circular reactions through the increasing venosity of the blood caused by interference with the respiration. Such venosity may be due to the convulsions and perpetuate them until death closes the scene.

A similar condition may arise from the prolonged convulsions which sometimes occur in general paralysis. In both these disorders there are mechanical conditions which, as Mott points out, produce a Vicious Circle terminating in progressively increased venosity of the blood in the cortex, especially of that portion supplied by the carotid arteries.<sup>1</sup>

Allied to epileptic attacks are various forms of tic and habit spasms, which often persist long after the cause has been removed. They were attributed by Hunter to the "memory of the body." The attempt to restrain a habit spasm may be accompanied by a distinct mental distress, and great relief is felt when the rhythmic discharge has occurred. To the same group belong the neuroses of blushing and stuttering.

Vices of all kinds beget a craving which favours further indulgence.

The familiar form of insanity known as "folie circulaire" also shows a strong tendency to rhythm, which tendency is apt to grow habitual and show itself on easier provocation. The initial depression passes through exhaustion into mania which produces toxæmia and reappears as depression.

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<sup>1</sup> Allbutt and Rolleston, *System of Medicine*, VII., p. 226.  
Cf. also *Archives of Neurology*, I., p. 502.

**Paralysis of Thermotaxis.** An interesting sequence of events may result from a weakening or paralysis of the thermotaxic mechanism, such as may follow a dangerously high or low temperature. For example, pyrexia may paralyse that mechanism, as a result of which the temperature of the body may rise to a fatal level. One of the commonest causes of such hyperpyrexia is rheumatic fever, in reference to which W. S. Church writes :

“In whatsoever way the paralysis of the heat-regulating centres is produced, a Vicious Circle is set up, resulting in an over-heated condition of the body, and a consequent deterioration of tissue, the muscular tissue of the heart especially suffering.”<sup>1</sup>

Prolonged exposure to cold illustrates the opposite condition.

**Coma.** Coma is often due to a high intra-cranial pressure and tends to keep up that pressure through the associated respiratory embarrassment. Owing to the lowering or abolition of the reflexes, saliva, food and drink often collect in the trachea, and, not being expelled by reflex cough, hamper respiration and cause venous engorgement, circumstances which aggravate the already high intra-cranial pressure.

## II. ORGANIC DISEASES

Organic diseases of the nervous system present some circular reactions of great clinical importance, several of which may terminate fatally.

**Cerebral Hæmorrhage.** Under healthy conditions there is an enormous difference between the blood-pressure in the cerebral arteries (*ca.* 120 mm. Hg) and the intra-cranial pressure (*ca.* venous pressure, i.e. little above zero). Cerebral hæmorrhage, however, tends to raise the intra-cranial pressure to a

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<sup>1</sup> Allbutt and Rolleston, System of Medicine, II. (i.), p. 627.

level approximating to arterial pressure, and thus squeezes the blood out of the vaso-motor centres, so as to render them anæmic (**Plate II. e**). In their urgent need for blood these centres respond by effecting a splanchnic vaso-motor constriction, so great at times as to raise the arterial pressure to as high as 400 mm. Hg or more.

The irony of the situation thus produced is that the rise, so beneficent in one respect, is apt to prove disastrous by starting the hæmorrhage afresh or by increasing the flow. A further rise of intracranial pressure then results, and the whole sequence is repeated.<sup>1</sup>

Cerebral hæmorrhage frequently proves fatal by pressure on the respiratory centre. If the patient survives the danger of respiratory paralysis, a further complication may arise and increase the hæmorrhage. As the diffused blood lacerates the soft brain tissues, an enlarging cavity is formed which is filled with blood at nearly arterial pressure. The larger such a cavity grows the greater is the pressure exerted by the blood, on the principle of the hydraulic press, while conversely the greater the pressure the more does the cavity enlarge. In fact it is difficult to see how hæmorrhage into the brain ever ceases, unless by pressure on the artery itself.

If the high pressure persists for any considerable time, further correlations are established. The vaso-motor centre becomes exhausted and loses its grasp over the splanchnic area, which fills with blood. Hence results cerebral and cardiac anæmia, which leads to further exhaustion of the centre.<sup>2</sup>

**Hydrocephalus.** The progressive development

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<sup>1</sup> Janeway, *Clinical Study of Blood-pressure*, pp. 142, 149.  
Cf. also Hirschfelder, *Diseases of the Heart and Aorta*, p. 46; Lewandowsky, *Handbuch der Neurologie*, III. (ii.), p. 40.

<sup>2</sup> Janeway, *l.c.*, p. 160.



of hydrocephalus may be due to an important self-aggravating process (**Plate II. f**). The disorder may originate in some obstruction to the foramen of Majendie or to one of the communicating channels, causing fluid to accumulate in the ventricles. The dilated ventricles may so displace the adjacent parts as to increase the obstruction to which the accumulation was primarily due. For example, the cerebellum and medulla may be pressed into the foramen magnum so as to plug that aperture. Such plugging in turn increases the distention of the ventricles and renders the condition a self-perpetuating one. In other cases the dilated ventricles (by compressing the membranes of the nerve roots) may close both lymphatics and veins, which closure in its turn leads to a greater accumulation of fluid.<sup>1</sup>

A similar process is observed in cerebro-spinal and other forms of meningitis. The foramen magnum is sometimes plugged by the displaced cerebellum as if by a cork.<sup>2</sup>

**Œdema of the Brain.** Various writers have called attention to the self-perpetuating processes in œdema of the brain.

Treves writes :

“Owing to the peculiar anatomical condition of the brain, situated as it is in an almost inexpandible cavity, when an œdema has once commenced, a *circulus vitiosus* is established, leading to a progressive increase in the œdema.”<sup>3</sup>

Leonard Hill also writes :

“The high blood pressure which exists in those capillary areas surrounding the seat of complete vascular obliteration will lead to increased transudation of fluid, since plasma may pass more easily into the brain

<sup>1</sup> *British Med. J.*, 1911, I., p. 808.

<sup>2</sup> Carnegie Dickson, *British Med. J.*, 1917, I., p. 454.

<sup>3</sup> *System of Surgery*, II., p. 119.

substance than the blood through the compressed capillaries. The transudation will take place at almost arterial tension, will increase the volume of the foreign body, and so will lead to compression of other capillary areas. A *circulus vitiosus* is thus established and the cerebral anæmia may spread indefinitely."

And again :

"In meningitis, tubercular meningitis and cerebral abscess, compression can arise by the accumulation of inflammatory exudations, by inflammatory dilatation, by thrombosis and blocking of vascular areas ; and whenever the Sylvian aqueduct and the veins of Galen are obliterated by intraventricular transudation. In all these pathological states a *circulus vitiosus* can be established leading to advancing cerebral anæmia. The pathological cause of ventricular hydrocephalus is no doubt to be found in blocking of the veins of Galen and the Sylvian aqueduct."<sup>1</sup>

**Cerebral Congestion.** In cases of locomotor ataxy and general paralysis the venous congestion and increased psychical activity of the neurons frequently react on each other, the correlations being probably due to the mechanical conditions favouring stasis in the frontal and central convolutions, and being especially common where syphilis has lowered the "durability" of the nervous system.

Mott writes :

"Psychical activity will cause hyperæmia and congestion of the brain, and in regions where there is a tendency to stasis the congestion may persist, especially if it leads to insomnia. A Vicious Circle becomes established by conditions which tend, on the one hand, to perpetual venous congestion in certain regions, and, on the other hand, to increased excitability of the neurons ; these factors mutually interact."<sup>2</sup>

<sup>1</sup> Physiology and Pathology of the Cerebral Circulation, pp. 188, 197, 200.

<sup>2</sup> *Lancet*, 1900, II., pp. 81, 3 ; 1913, II., 1470.

Other injurious circular reactions may be established in various conditions in which there is a rapid destruction of neurons.

These Mott has also described :

“Two conditions may mutually interact upon one another in the establishment of a Vicious Circle, *viz.* degenerating nervous structures, the degenerated products of which accumulate and irritate the perivascular lymphatics surrounding the veins, causing a tendency to stasis and inflammation, combined with conditions which produce mechanical congestion in the veins ; and this reacting back on the nerve structures leads to still further disintegration of nervous tissue : and thus the one vicious condition feeds the other.”<sup>1</sup>

**Poliomyelitis.** In anterior poliomyelitis and other forms of paralysis morbid correlations may result from a disuse of the associated muscles. There is in fact “a circle of reflex and trophic influences” affecting the whole apparatus of nerve cell and muscle, and reacting on one another through interference with the regular exchange of stimuli.

The progress of events is well illustrated in acute anterior poliomyelitis when indeed two distinct complications may occur, one earlier in the course of the disease than the other.

The first complication results from a disturbance of the reciprocal relations that exist between the tropho-motor neurons and their associated muscle-cells. In favourable cases the inflammation of the neurons of the anterior cornua rapidly subsides and the neurons recover more or less completely, the percentage of recoveries being estimated at about 15 per cent. Recovery, however, depends not merely on the central lesion, but also on the main-

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<sup>1</sup> *Archives of Neurology*, I., pp. 42, 179, 188, 189, 191, 501-2.  
Cf. also *British Med. J.*, 1911, II., p. 1415.

tenance of nutrition and contractility of the dependent muscles. If these muscles remain untreated and disused and atrophy, they react injuriously on the damaged neurons which lose the stimuli which should reach them from the periphery, and thus perpetuate the disease.

Robert Jones describes the process :

“ The muscle has wasted from disuse and become incapable of responding to such feeble impulses as come to it from an impaired nerve cell. Consequently the normal afferent impulses do not pass up to the nerve cell, because the muscular action which originates them is absent, and the whole reflex apparatus by which the spinal nerve cell and muscle react on each other to their mutual benefit is put out of gear. . . . Recovery of muscular action does not take place spontaneously because the whole apparatus—nerve cell, nerve trunk and muscle—are in a state of disuse atrophy, and continue to remain so, because the muscle, from its mechanical disadvantage, cannot perform its function of contracting, which is an essential part in the circle of reflex and trophic influences.”<sup>1</sup>

In severe cases a second complication occurs. Owing to the pull of healthy antagonistic muscles, the weakened muscles associated with the central lesion are over-stretched, and the result is a lessened contractility, increased weakness and deformity. Over-stretching leads to weakness and weakness conduces to over-stretching. The muscles are thus rendered less and less able to supply the stimuli necessary for the nutrition and recovery of the central neurons.<sup>2</sup>

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<sup>1</sup> *British Med. J.*, 1914, I., p. 1166. Cf. also Hutchison and Sherren, *Index of Treatment*, p. 511.

<sup>2</sup> A good account of the similar “ Vicious reflex Circle ” in spastic paralysis is given by Tubby and Jones, *Modern Methods in the Surgery of Paralyses*, p. 215.

## Chapter Jfour

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### THE CARDIO-VASCULAR SYSTEM



OWING to the importance of the cardio-vascular system in the economy, and to the complexity of the vital and mechanical phenomena involved, the circular reactions created by disease are of the highest interest. These reactions are difficult to classify on any scientific principle, since the various parts of the cardio-vascular system are so closely dependent on one another. Nevertheless an attempt at classification must be made, although overlapping is inevitable.

We shall discuss in order :

- I. The Myocardium
- II. The Endocardium
- III. The Pericardium
- IV. Cardiac Neuroses
- V. The Blood-Vessels and Lymphatics
- VI. The Blood

#### I. THE MYOCARDIUM

**Failure of Compensation.** The compensatory changes in the myocardium, which result from increased resistance in the pulmonary and systemic circuits, constitute a striking example of the remedial adaptations of nature. In the course of time, however, these compensatory changes usually fail and end in cardiac dilatation and stasis. Hence



results interference with circulation, respiration, digestion, absorption and elimination. The unfortunate myocardium already labouring under special difficulties *a fronte* is poisoned by the products of imperfect metabolism which reach it *a tergo*, sap its nutrition and intensify its weakness.<sup>1</sup> The vortex steadily increases by involving one organ after another, like "a circle in the water which never ceaseth to enlarge itself."

The important circular reactions thus established may be divided into short, medium and long circuits. The first is concerned with the myocardium and its coronary vessels, the second with the myocardium and the pulmonary circulation, and the third with the myocardium and the peripheral circulation. These several reactions aggravate the cardiac failure (Plates I., III. a, b). All the viscera may in turn be thrown into disorder and aggravate the cardiac weakness. Thus we may have what Barié terms "un foie cardiaque, un poumon cardiaque, un rein cardiaque, une rate cardiaque," and so forth.

A. The first organ to suffer from the heart failure is the heart itself, since the coronary circulation depends on systolic activity.

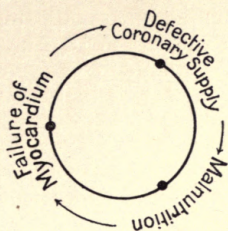
West writes :

"When the congestion travels beyond the right ventricle, one of the first sets of veins to feel its effects is the coronary. In this way the circulation of the whole heart is affected, and its nutrition suffers still more. The weakness of the left ventricle is thus further increased, and therefore the congestion produced by it, and so a Vicious Circle is established which, if not broken, quickly leads to a fatal issue."<sup>2</sup>

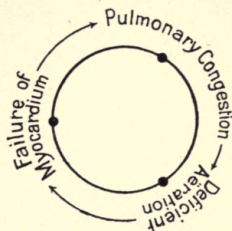
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<sup>1</sup>M. Bruce, *Lancet*, 1911, II., 210 ; Pembrey and Ritchie, *General Pathology*, p. 283.

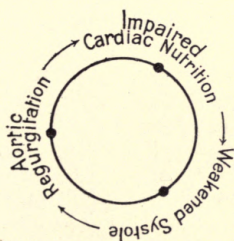
<sup>2</sup>Diseases of the Organs of Respiration, I., p. 237.



(a) CARDIAC FAILURE



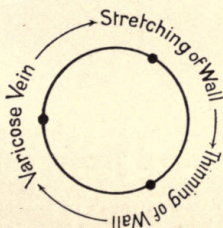
(b) CARDIAC FAILURE



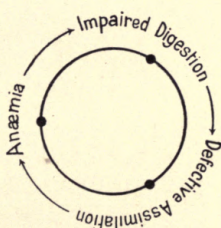
(c) AORTIC REGURGITATION



(d) PERICARDITIS



(e) VARICOSE VEIN

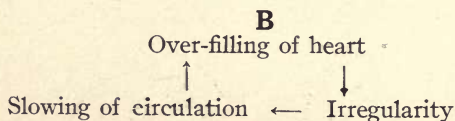
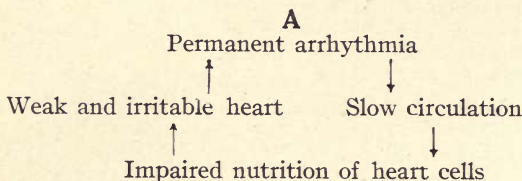


(f) ANÆMIA

Plate III.—Circles associated with the Cardio-Vascular System.

Various disorders are associated with arrhythmia. Such arrhythmia, on the one hand, may slow the circulation, thus tending to produce cyanosis by increasing the CO<sub>2</sub> in the blood and diminishing the tone of the cardiac muscle. On the other hand, the long pauses increase the venous pressure, while the influx of venous blood under a relatively increased pressure, acting on a cardiac muscle whose tone is diminished, favours over-distention. The over-distention by increasing the diameter of the ventricular chamber increases the hydrostatic pressure on its walls and causes the heart to work at a disadvantage.

Hirschfelder thus represents two of "the Vicious Circles of the irregular heart :"<sup>1</sup>



In other cases progressive paroxysms of auricular fibrillation occur. Such paroxysms are due to the fact, experimentally observed, that, as Lea points out, "auricular fibrillation itself tends to increase the irritability of the auricle and so sets up a Vicious Circle."<sup>2</sup>

<sup>1</sup> Diseases of the Heart and Aorta, pp. 123, 127. Cf. also *J. of American Med. Ass.*, 1908, II., p. 476.

<sup>2</sup> *Lancet*, 1912, II., p. 1216.

Other reciprocally acting processes result from degenerative changes of the myocardium, and the associated dilatation of the cardiac chambers. Since the strain on the walls of a sphere or spheroid increases with its circumference, the weakened and dilated cardiac walls yield the more under the strain of the systolic pressure ; the more they yield the greater the strain and *vice versa*. Dilatation begets dilatation. Even the fall of velocity under such conditions perpetuates itself.<sup>1</sup>

In cases of advanced myocardiac degeneration actual rupture of the heart may occur, followed by hæmorrhage and rapid fall of blood-pressure. This fall in its turn stimulates the vaso-motor centre in the bulb and provokes a general vaso-constriction, which again raises the blood-pressure and intensifies the hæmorrhage, thus hastening death.

Another injurious process may be associated with the Adam-Stokes syndrome, i.e. the co-existence of extreme bradycardia and syncopal or convulsive seizures.

Lewandowsky writes :

“ In cases of partial heart-block the condition may pass into one of complete heart-block, possibly owing to an increased frequency of the auricular contraction due to psychical excitement or to exertion. In such cases the stimuli may be insufficient, as the experiments of Erlanger have shewn (relatively complete heart-block). The resulting interference with the circulation through the brain or the medulla then brings on the attack.

An extra-cardiac origin is also conceivable in cases where the bulbar activity is impaired owing to vaso-constriction or to a temporarily defective vascular supply—i.e. where there is intermittent loss of functional activity of the medulla. Such a condition might in its

<sup>1</sup> Allbutt, Diseases of the Arteries, II., p. 58.

turn act on the heart, and by means of a Vicious Circle react again through the heart on the brain.”<sup>1</sup>

Failure of compensation is sometimes complicated by extreme tachycardia, the pulse-rate reaching 250 or even 300 per minute, and the blood-pressure falling to as low as 50 mm. Hg. Such a low pressure indeed is a serious danger in itself and may lead to sudden death. Moreover the interval between the cardiac beats is so short that the ventricles can neither fill nor empty themselves as they should. These conditions perpetuate the tachycardia and low pressure.

Huchard writes :

“ A Vicious Circle is created from which the sufferer cannot escape until his depressed arterial blood-pressure has been raised.”<sup>2</sup>

B. After the myocardium itself the lungs bear the brunt of cardiac failure, the diminished propulsive and suction forces being perhaps equally injurious. Stasis in the lungs spells impaired aëration, and impaired aëration spells increased myocardial weakness. Thus there is reciprocal embarrassment in two of the most vital parts of the organism.<sup>3</sup> A similar embarrassment is met with in many diseases associated with cardiac failure, e.g. bronchitis, pneumonia, acute pulmonary œdema, hypostatic pulmonary congestion etc.

Cardiac failure is frequently complicated by paroxysms of dyspnœa which tend to aggravate the condition. The attacks usually occur during sleep

<sup>1</sup> Handbuch der Neurologie, V. (iv.), p. 12.

<sup>2</sup> Maladies du Cœur et de l'Aorte, I., pp. 16, 100. Cf. also Pavlov, The Work of the Digestive Glands, p. 233 ; *American J. of Surgery*, 1914, II., p. 11.

<sup>3</sup> Fothergill gives an excellent account of the pathological sequences in which the heart and lungs are involved. *Lancet*, 1874, II., p. 682.



or in the early morning when the blood-pressure is low, and give rise to extreme dyspnœa, tumultuous palpitation, acute distress, insomnia and prostration. Various pathological conditions may excite such an attack ; but broadly speaking they spring from cardiac inadequacy while in their turn they increase the inadequacy and may terminate fatally. The cardiac and respiratory rhythm are thrown into confusion and the want of harmonious action throws an extra strain on each of them.

C. The third group includes the peripheral circulation, and especially the portal system.<sup>1</sup>

Barié thus describes “ le foie cardiaque ” :

“ The liver, whose functions are thrown out of gear as a result of cardiac failure, in its turn reacts on the heart and aggravates the venous stasis on the right side of the heart. Thus it comes about that heart failure associated with hepatic diseases (asystolie hépatique) gives rise to a veritable Vicious Circle, due to the heart and the liver alternately reacting on one another.”<sup>2</sup>

Some cases of cardiac failure are complicated by flatulent distention of the stomach due to the consequential congestion of the stomach. Such

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<sup>1</sup> Every *circulus vitiosus* has of course its corresponding *circulus virtuosus*. For example, the three circuits—short, medium and long—would form the following physiological sequences in the healthy individual :—

- A. Vigorous systole : active coronary circulation : good nutrition of myocardium : vigorous systole.
- B. Vigorous systole : active pulmonary circulation : efficient oxygenation : vigorous systole.
- C. Vigorous systole : active visceral circulation : good digestion and nutrition : vigorous systole.

<sup>2</sup> Maladies du Cœur et de l'Aorte, pp. 632, 771.

cardiac embarrassment can actually turn the scale against recovery when life is trembling in the balance. Halls Dally who illustrates this condition diagrammatically gives the following as the ten component factors of this "cardio-gastric Vicious Circle" : failure of compensation : portal congestion : catarrh of stomach : delayed or imperfect digestion : fermentation and flatulence : raising of diaphragm : displacement of heart : kinking of great vessels : raised venous and lowered arterial pressure : cardiac over-strain and so back to failure of compensation.<sup>1</sup>

These visceral complications might be extended so as to include the spleen, the intestines, the kidneys and so forth. Indeed the entire peripheral circulation is involved. But as the same principle is at work further details are unnecessary ; they all go to show how often the heart, in the words of Allbutt, "falls into the Vicious Circle of doing as ill for itself as for other parts of the body."<sup>2</sup>

**Cardiac Strain.** Some striking circular reactions are met with in cases of acute dilatation due to over-exertion. For example, the dilatation may cause such weakening of the coronary circulation that the myocardium loses much of its contractile power. The result is a further diminution of the coronary supply, followed by still further weakening of the cardiac muscle. This sequence results from the fact that the cardiac muscle is fed by the blood which it circulates and is thus self-dependent.

The dramatic death of Eucles after the victory at Marathon was probably due to acute dilatation. After racing to Athens with the good news he was

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<sup>1</sup> *Progressive Medicine* (1913), III., p. 100. Cf. also Stacey Wilson, *The Early Diagnosis of Heart Failure*, p. 368.

<sup>2</sup> Allbutt and Rolleston, *System of Medicine*, III., p. 388.

just able to shout the words *χαίρετε, χαίρομεν*, before he fell dead.<sup>1</sup>

Cardiac dilatation, according to Ehrnrooth, is largely due to diminished contact between the muscle cells since such lessened contact (in the absence of nerve fibres) diminishes conductivity. Stasis also supervenes before long, followed by exudation which further diminishes contact.

Ehrnrooth writes :

“In this way a Vicious Circle is established which affects the primary functions of the muscular tissues.”<sup>2</sup>

In other cases an over-strained and weakened heart is associated with an abnormally high pressure. The slowing of the circulation due to the strain tends to produce anæmia of the medullary centres, which respond by inducing intense vaso-constriction, thereby driving a larger quantity of blood to the medullary centres. The already weakened heart is called upon to make a supreme effort, and the weaker it is the more do the imperious medullary centres call for blood. The cardiac weakness and the bulbar anæmia aggravate each other, and the increased arterial pressure may be kept up to the end in persons dying of heart failure induced by that high pressure. The forced draught under which the hydro-dynamic system is working leads to its destruction.<sup>3</sup>

Somewhat similar conditions may result from acute, more especially zymotic, disease, such as pneumonia, influenza, diphtheria and enteric fever. Indeed any disease that gravely diminishes the

<sup>1</sup>Plutarch, *Opera Moralia*, ed. by Didot, I., p. 425. Cf. also Barié, *Maladies du Cœur et de l'Aorte*, pp. 612, 631.

<sup>2</sup>Über Plötzlichen Tod durch Herzlähmung, p. 24.

<sup>3</sup>A high venous pressure may also create a dangerous circular reaction. Norris, *Blood-Pressure*, p. 20.

cardio-motive forces may bring this morbid correlation into play. Weak systole : inadequate circulation : weaker systole—represents a dangerous sequence. In serious attacks "there is a Vicious Circle of conditions which precludes all hope of recovery."<sup>1</sup> Especially is this result probable when the blood supplied to the myocardium is laden with impurities, or when there is a progressive accumulation of residual blood leading to increasing dilatation of the ventricle. Then indeed does life hang by a thread which may snap at any moment.

**Coronary Sclerosis.** Malnutrition of the myocardium is not infrequently due to sclerosis of the coronary arteries, a condition which accounts for the sudden death of many elderly persons. After gradually advancing for years, the sclerosis may reach a stage when the lumen of the coronary arteries is almost blocked by degenerative changes so that the blood-supply to the myocardium is seriously curtailed. The increased resistance produced by the sclerosis requires a more forcible systole, if life is to continue, whereas the systole is actually weakened owing to the diminished blood-supply, and the weakening further impairs the coronary circulation. At last the heart gives up beating.

"The insufficiency is due to the Vicious Cycle created by lowering the pressure in the coronary arteries, which occurs directly the ventricle is unable to maintain the required aortic pressure. Thus at the very time when the heart muscle requires the greatest supply of nutrition, the supply of blood to the myocardium lessens."<sup>2</sup>

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<sup>1</sup>Osler and Macrae, *System of Medicine*, IV., p. 125. Cf. also Cohnheim, *General Pathology*, III., p. 1416.

<sup>2</sup>Osler and Macrae, *System of Medicine*, IV., p. 31. Cf. also M. Bruce, *Lancet*, 1911, II., pp. 70, 206 ; MacCallum, *Text-Book of Pathology*, p. 467.

Angina pectoris is often associated with this pernicious sequence of events, the pain being probably due to spasm or cramp of the cardiac muscle which cannot obtain an adequate supply of blood.

## II. THE ENDOCARDIUM

The compensatory changes which take place when the myocardium has to meet increased resistance have been alluded to in the previous section.<sup>1</sup> Such increased resistance is frequently caused by valvular disease, and *mutatis mutandis* similar compensatory changes result. Here also in course of time decompensation follows, and gives rise to the secondary conditions described in connection with the failure of the myocardium.

Gibson writes :

“ Sooner or later, according to its form and severity chronic valvular disease with compensation itself disposes to failure by establishing a Vicious Circle of slow progressive impairment of the viscera and their great vital functions—the lungs, liver, stomach, bowels, kidneys, indeed the myocardium itself.”<sup>2</sup>

The several valvular lesions, however, may establish special correlations which are peculiar to themselves, and these are worthy of a brief consideration, for, as Bouillaud says : “ The various diseases of the heart may themselves cause other diseases in that organ.”<sup>3</sup>

<sup>1</sup> Pembrey and Ritchie point out that when a hypertrophied heart exceeds a certain size its work is increased by the restrictions of the bony thorax. Thus hypertrophy may mean more work and still greater hypertrophy. General Pathology, p. 287.

<sup>2</sup> Text-Book of Medicine, II., p. 127. Cf. also H. Sainsbury, *Lancet*, 1917, II., p. 871.

<sup>3</sup> Huchard, *Maladies du Cœur et de l'Aorte*, III., p. 717.



**Aortic Regurgitation.** Regurgitation due to disease of the aortic valves is, under favourable circumstances, compensated by hypertrophy of the left ventricle, which supplies the increased driving power necessitated by the lesion (**Plate III. c**). For many years the individual affected may lead a useful comfortable life, and be scarcely conscious of anything amiss. Sooner or later, however, the hypertrophied ventricle undergoes an injurious degree of dilatation. The myocardium is insufficiently irrigated and nourished, and the condition may lead to sudden death. The following is the fatal sequence : regurgitation, impaired coronary circulation, dilatation, weakened systole and increased regurgitation.

Incompetence of the aortic valve may also result from disease and dilatation of the aorta, especially in middle and old age. This is in turn followed by dilatation and lessened competence.

McKisack writes :

“The ventricle under these circumstances usually becomes dilated, partly as a result of fatty and fibrous degeneration, and partly as the effect of mechanical causes set up by the defective aortic valve, so that a Vicious Circle is established.”<sup>1</sup>

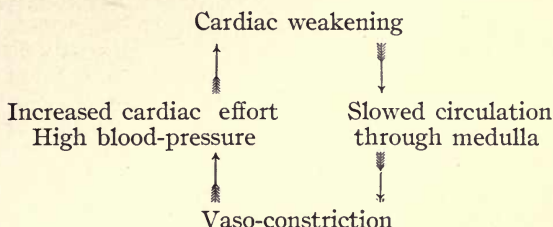
Occasionally an aortic valve may rupture under severe exertion, thus throwing a sudden strain on the heart for which it is unprepared. The same injurious sequence takes place, but as there has been no time for compensatory change the effects are more serious and instantaneous death may occur.

Broken compensation associated with aortic insufficiency may also be complicated by a high diastolic pressure which aggravates the insufficiency.

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<sup>1</sup>*British Med. J.*, 1911, II., p. 1397.

Hirschfelder thus represents the correlations :<sup>1</sup>



**Mitral Stenosis.** Mitral stenosis is one of the commonest causes of heart failure. The nutrition of the auricular musculature suffers greatly and this hampers the flow of blood through the stenosed orifice.

Coombs writes :

“ In a large majority of all cases of mitral stenosis death is due to gradual cardiac failure. The powers responsible for this are two. The heart and especially the left auricle are asked to do more work by reason of the valvular obstruction ; and further the gradually increasing venous stasis undermines the nutrition of the cardiac, and particularly of the auricular musculature. An unconquerable Vicious Circle is now established.”<sup>2</sup>

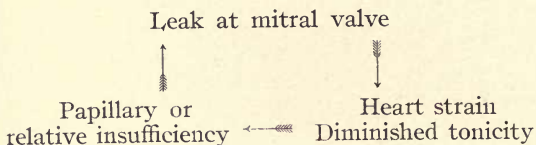
**Mitral Regurgitation.** When mitral regurgitation is consequent on aortic regurgitation or obstruction (owing to progressive dilatation of the ventricle and auriculo-ventricular orifice) there may be a reciprocal influence on each other of the aortic lesion and the mitral regurgitation. The cumulative result is usually disastrous.

<sup>1</sup>Diseases of the Heart and Aorta, p. 315.

<sup>2</sup>Rendle Short, Index of Prognosis, p. 221.

Another sequence may be associated with mitral regurgitation when the cusps of the valve are not brought tightly together, owing to want of cardiac tone. A small leak may thus be transformed into a serious one, leading to a further diminution of tonicity.

Hirschfelder thus represents the condition :<sup>1</sup>



**Tricuspid Regurgitation.** Tricuspid regurgitation sometimes results from the dilatation of the right ventricle, secondary to mitral disease. For a time the reflux may relieve the overloaded ventricle, but its ultimate effect is to render the ventricle less competent to overcome the obstruction, thus tending to increased dilatation.

**Septic Endocarditis.** In the case of septic endocarditis an infective Circle may be established by the micro-organisms circulating in the blood. These microbes lead to vegetations and erosions in the endocardium, especially that lining the valves, and these vegetations throw off showers of infective emboli carrying infection far and wide and leading to further endocardial lesions. For example, the vegetations due to rheumatic fever are highly susceptible to attack by the streptococcus, pneumococcus, gonococcus or similar organisms.

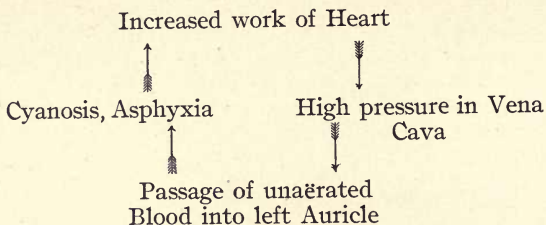
<sup>1</sup> Diseases of the Heart and Aorta, p. 414. Cf. also Allbutt, Diseases of the Arteries, I., p. 129.

Valvular disease usually leaves a legacy of mischief behind. The patient does not die but remains an invalid, the *sanatio incompleta* being shown by a disposition to relapse, by a diminished power of resistance to fresh attack. As a taper just blown out will snatch the flame from the torch that scarcely touches it, even so readily is the endocardiac mischief rekindled. Thus the valvular mischief and the lowered resistance act and react on each other, often ending in extensive and cumulative mischief.

When valvular lesions occur in such persons as navvies or coalheavers, whose daily occupation involves severe exertion, disastrous consequences usually follow much earlier than they would do were the *régime* of life more favourable to compensation. Many a premature death has occurred where poverty or adverse fortune has compelled a life of toil. The labour aggravates the heart lesion ; the heart lesion makes the daily task relatively, if not absolutely, harder.

**Congenital Heart Disease.** Congenital heart disease is usually due to imperfection either of the valves or of the septa caused by foetal endocarditis. The malformation frequently interferes with the nutrition of the myocardium, thus diminishing its blood-supply and further impairing systolic activity. For example, a patent foramen ovale when associated with pulmonary stenosis often gives rise to reciprocal disorders. So long as a quiet mode of life is pursued, sufficient blood passes through the lungs to keep the blood aërated, while the remaining blood passes through the foramen ovale which offers less resistance. But as soon as active exercise is taken, a larger quantity of blood passes direct into the left auricle and ventricle (owing to the pulmonary stenosis) and thus escapes oxygenation. The consequence is a rise in venous pressure which drives still more blood through the foramen ovale.

Hirschfelder thus represents "the Vicious Circle of the open foramen ovale."<sup>1</sup>



In other forms of congenital morbus cordis the venous stasis may give rise to prolonged convulsions. These in their turn interfere with respiratory movements, aggravate the venosity and involve a grave menace to life.

A third condition may occur in cases of congenital malformation associated with cyanosis. The general venous stagnation causes dilatation and tortuosity of the capillaries in the skin as well as in the internal organs and such dilatation increases the stasis.<sup>2</sup>

### III. THE PERICARDIUM

The pericardium is a comparatively simple structure when compared with the heart which it envelops, and is not so frequently affected by injurious circular reactions. Nevertheless, as in the case of other serous membranes, there are certain reciprocations to which attention may be drawn.

Slight attacks of pericarditis may be followed by complete recovery even when there has been some fibrinous exudation. After a series of attacks,

<sup>1</sup>Diseases of the Heart and Aorta, pp. 528, 539.

<sup>2</sup>Osler and Macrae, System of Medicine, IV., p. 335. Cf. also *St. Thomas' Hospital Reports* (1888), XVIII., p. 285.



however, the *restitutio ad integrum* is generally imperfect. The acute attack subsides, but leaves behind a liability to recrudescence ; the damaged pericardium on slight exposure to chill or infection is attacked afresh, and each time the damage increases, until the cumulative effects may be prodigious. The residual lesion predisposes to recurrence ; recurrence aggravates the primary residual lesion.

**Pericardial Effusion.** Pericardial effusions may be self-aggravating through interference with the mechanism known as the lymphatic pump, by means of which a constant circulation of fluid into, and out of, the pericardial cavity is maintained. This pump is worked by means of the cardiac and respiratory movements acting on the lymphatics and stomata ; owing to this mechanism the pericardial sac as a rule contains no free fluid.

In cases of effusion the stomata are readily blocked by fibrinous deposits, which check the escape, and thus lead to an increase, of the effusion. The stomata and superficial lymphatics are also liable to be compressed, the channels of absorption being thus choked (**Plate III. d**).

Again the effusion impairs the cardiac movements on which depends the efficiency of the pump, and compresses the great vessels at the roots of the lungs, heart and pericardium. The circulation is hampered and the hampering increases the effusion. These reciprocally acting factors may explain why pericardial effusions are often very persistent.

Fluid in the pericardium, whether resulting from effusion or from rupture of an aneurysm, may involve deadly peril when it interferes with the stretching of the cardiac walls which is so essential to the development of their energy.

Forsyth gives the following account of a fatal

sequence due to this condition :

“ There can be no doubt that the pericardial effusion was the cause of death, and that its fatal effect was due to mechanical interference with the circulation. Six ounces of fluid were rapidly poured out around the heart. The strong fibrous coat of the pericardium was too rigid to relax for its accommodation, and a sac large enough to contain only the heart was now occupied by the heart and effusion. The result was a positive pressure in the pericardium leading to compression of the thin-walled venæ cavæ and obstructed return of blood to the auricles. The pulmonary veins shared the fate of their neighbours, and their blood was stemmed back until the lung capillaries grew over-swollen. This led to œdema of the lungs and a copious exudation into their alveoli of serum and even blood, the irritation of which stirred up violent attacks of coughing. The coughing raised the intra-thoracic pressure still higher and the diastolic filling of the heart became a matter of difficulty. This again aggravated the lung condition, and so the Vicious Circle went round—heart, lung, lung, heart—with the pericardial effusion for its centre.”<sup>1</sup>

Hydro-pericardium is a frequent complication of heart failure and results from general venous stasis, under similar conditions as does dropsy of the pleural or peritoneal cavities. The fluid, if abundant, aggravates the circulatory embarrassment by interference with the cardiac, especially the diastolic movements, much as in the case of acute pericarditis just referred to. Such dropsical effusion often constitutes a terminal phenomenon.

Gibson writes :

“ Hydro-pericardium may be said to step in as the closing link of a pathological chain, and once it has

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<sup>1</sup> *Clinical J.*, XXVII., p. 220. Cf. also *Lancet*, 1917, I., p. 292 ; Constipation and some Associated Disorders, pp. 130-1.

made its appearance it unites with the other morbid conditions to form a Vicious Circle of fatal import.”<sup>1</sup>

#### IV. CARDIAC NEUROSES

Cardiac neuroses have already been briefly alluded to in connection with neurasthenia (Cf. p. 17). But there are other circular reactions to which attention may be drawn. An example is sometimes seen when a practitioner erroneously diagnoses a “weak heart” and excites in his patient an ever-present dread of serious illness or immediate death; the injurious process is here due to heterosuggestion. Sir Douglas Powell aptly illustrates this form of neurosis by the story of a young woman, once the picture of health and vigour, whose doctor had diagnosed a “weak heart.” She had been taking the utmost care of a healthy organ ever since, resting half the day, never even walking upstairs, until she became fat, breathless, anæmic and miserable. Many months elapsed before she could be weaned back to her former healthy activity, if indeed recovery were even then possible.<sup>2</sup>

A similar lamentable condition is sometimes brought about when excessive repose is prescribed after an attack of angina or some other functional disorder.<sup>3</sup> The over-rested heart grows more and more unequal to its task, and more and more irritable when extra demands are made upon it. The sufferer also tends to grow obese with a sluggish circulation which further impairs cardiac activity.

When a neurotic temperament is associated with real *morbus cordis*, other injurious correlations may be established if the patient takes an unduly gloomy

<sup>1</sup> Diseases of the Heart and Aorta, p. 386. Cf. also Saundby, Old Age, p. 87.

<sup>2</sup> Treatment in Diseases and Disorders of the Heart, p. 15.

<sup>3</sup> Huchard, Maladies du Cœur et de l’Aorte, II., p. 140.

view of his malady. Such pessimism delays compensation and must be strenuously combated. Frequently the physician who realises the value of equanimity in promoting compensation, and how a knowledge of the whole truth may rob a patient of all peace of mind may hesitate as to how much he should reveal. As Fräntzel says : " Das Wissen is oft viel schlimmer als die Krankheit selbst."

M. Bruce refers to the condition :

" Depressing emotions contribute to failure of compensatory hypertrophy of the heart, and in this respect a Vicious Circle is formed, which can often be broken by judicious management."<sup>1</sup>

In other neurotic patients a functional disorder such as palpitation may start the morbid train of symptoms. The palpitation may be so violent as to cause an apprehension of sudden dissolution, and this apprehension in turn intensifies the palpitation.

Arrhythmia may also give rise to a severe neurosis. Moreover the habit of intermitting may cause an exaggerated irritability of the cardiac nerve centres, leading to a continuance of the abnormal action even after the removal of the primary cause.

Some cardiopaths are troubled with attacks of vomiting or cough, probably due to irritation of the pneumogastric nerves. Such reflex disturbances aggravate the cardiac trouble or may even prove fatal.<sup>2</sup>

**Angina Pectoris.** Angina pectoris is associated with such a variety of organic and functional disorders that it might legitimately be classified under several headings ; there may be myocardiac

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<sup>1</sup>Principles of Treatment, p. 81.

<sup>2</sup>M. Bruce, *l.c.*, p. 308.

failure, valvular lesion or peripheral or central spasmodic neuroses. One or more of these factors may be present and the allocation of the precise share of each in the attack may be impossible.

Morison thus describes some of the disorders which establish a circular reaction, but the conditions vary greatly :

“Such agencies as cold, emotional excitement, reflex disturbances from various organs, and certain poisons, which even tobacco may prove to be at times, may commence the Vicious Cycle by inducing the peripheral spasm which finds expression in angina. But that such peripheral conditions, even in these circumstances, require the presence at the centres of some state or states in the majority of cases, which aid the peripheral resistance to find expression in pain is, I imagine, quite indisputable. Given a weak spot at the centre, capable of registering a rise of pressure in the vascular system, that rise may be registered as pain, however the increase of pressure may be brought about, whether by central propulsion or peripheral resistance. But that a patient with dissecting aneurism of the coronary artery, with neurotic processes active in the aorta and coronary system, and with a delicate and minute innervation of every fibre in the cardiac muscle, should invariably wait upon the remote periphery for the signal of distress is simply unthinkable, and may even be regarded as an opinion no longer tenable.”<sup>1</sup>

## V. THE BLOOD-VESSELS AND LYMPHATICS

The blood-vessels have already been referred to as participating with the heart in the creation of injurious circular reactions. It will, however, be convenient to describe under a special heading some further disorders in which they play a prominent part.

<sup>1</sup>Sensory and Motor Disorders of the Heart, p. 112.



**Arterio-Sclerosis.** Important correlations exist between arterial sclerosis and cardiac hypertrophy, although pathologists are not agreed as to the precise sequence of events. At one time it was believed that the blood in chronic Bright's disease was poisoned by the products of metabolism, which were retained in the body instead of excreted through the kidneys. To protect the tissues from being damaged by this vitiated blood the arterial coats contracted and hypertrophied so as partially to cut off the supply. Then the myocardium in its turn hypertrophied in order to propel an adequate supply of blood through the narrowed tubes *et ainsi de suite*.<sup>1</sup>

Modern pathologists, however, regard arterio-sclerosis as a wide-spread process affecting the arterio-capillary system generally, causing increased resistance to the flow of blood and compensatory hypertrophy of the left ventricle. These two conditions—increased pressure and cardiac hypertrophy—are progressively reciprocal, the cardiac hypertrophy being a necessary physiological adaptation to meet the increasing peripheral resistance. On the other hand the resulting high arterial pressure leads to an increasing strain on the walls of the aorta and on the arterio-capillary system generally. Thus the arterial lesion may be both the cause and effect of the hypertension.

Warfield writes :

“ Prolonged hypertension is not a normal state, and sooner or later there must result changes in the circulatory system. Changes actually do occur in both the heart and the arteries, leading to the production of arterio-sclerosis and to the establishment of a Vicious Circle.”

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<sup>1</sup> H. Gilford, Disorders of Post-natal Growth and Development, p. 346. Cf. also Barr, *British Med. J.*, 1905, I., p. 53.

And again :

“ The primary change is an increased tension in the arterioles which later leads to thickening of the coats of the vessels and to the other consequences of arterial disease. A Vicious Circle is thus established which has a tendency to become progressively worse.”<sup>1</sup>

In the later stages of arterio-sclerosis the cardiac hypertrophy undergoes decompensation and the circular reactions already described on p. 35 are established.

**Aneurysm.** Aneurysm is frequently due to disease of the arterial walls, which consequently grow weak and yield to the blood-pressure. The more they yield the greater the tension ; the greater the tension, the thinner and weaker do they become. The dilatation is progressive.<sup>2</sup>

When rupture occurs a similar reciprocation is established as has been alluded to in cases of rupture of the heart. The hæmorrhage paradoxically raises the blood-pressure, death resulting from general anæmia. An illustrative case is described by Hensen in which an aneurysm of the descending aorta perforated the left bronchus and on three occasions gave rise to profuse hæmoptysis. Careful measurements of the blood-pressure showed that while the pressure just before an attack was 115 mm. Hg, it had risen to 142 mm. a quarter of an hour later. The patient survived the severe attack of hæmoptysis, probably owing to the perforation being closed

<sup>1</sup> Arterio-sclerosis, pp. 87, 113, 133, 163. Cf. also Allbutt and Rolleston, *System of Medicine*, VI., pp. 601, 606 ; Barr, *British Med. J.*, 1909, II., p. 61 ; Oliver, *British Med. J.*, 1910, II., p. 1333 ; Faught, *Blood-Pressure*, p. 285.

<sup>2</sup> If  $t$  stands for tension,  $r$  for radius, and  $p$  for blood-pressure, then  $t = \frac{1}{2} rp$ , i.e. with a constant blood-pressure the tension increases with the calibre of the vessel.

by a clot, but died shortly afterwards from a recurrence of the bleeding.<sup>1</sup>

**Varicose Veins and Lymphatics.** Another complication is associated with varicose veins, whether these are due to increased intra-venous pressure or to diminished resisting power of the vein-walls (**Plate III. e**). In either case the dilatation leads to increased tension, and the tension increases the dilatation. Incompetence of the valves constitutes a further aggravating factor.

Romberg writes :

“The venous dilatation (due to some mechanical obstruction) and the anatomical changes in the vein-walls act reciprocally on one another. Thus a *circulus vitiosus* whose pathogenesis is obscure controls the course of events.”<sup>2</sup>

Lymphangiectasis stands the same relation to the lymphatic system as does venous varicosis to the vascular. When lymphatics are unable to empty themselves they are easily stretched and weakened. The dilatation is thus progressive, especially when complicated by incompetency of the valves.<sup>3</sup>

**Capillary Stasis.** According to Cohnheim a “most pernicious *circulus vitiosus*” may be present when local inflammation leads to capillary stasis and coagulation, at any rate if the injury is so severe that complete repair is impossible. The inflammatory process leads to stasis and the stasis aggravates the inflammation.<sup>4</sup>

<sup>1</sup> *Deutsches Archiv f. klin. Medicin* (1900), LXVII., p. 497.

<sup>2</sup> *Krankheiten des Herzens und der Blutgefäße*, p. 496. Cf. also Nobl, *Der Varicöse Symptomencomplex*, p. 54.

<sup>3</sup> Busey, *Narrowing, Occlusion and Dilatation of Lymph Channels*, p. 116.

<sup>4</sup> *General Pathology*, I., pp. 339, 374-5.

The successive changes which take place in a tissue as a response to injury are (a) dilatation of the blood-vessels, (b) acceleration followed by retardation of the blood-stream, and (c) emigration of leucocytes and erythrocytes. These and the associated conditions are beneficent reactions and suffice under ordinary circumstances to repair the damage. The inflammatory process undergoes resolution and is followed by a *restitutio ad integrum*.

Where, however, the trauma is severe, graver sequelæ shew themselves; the circulation may come to a complete standstill, the vessel-walls cease to be nourished, the contained blood coagulates and the surrounding tissues perish. The products of tissue death and disintegration then become sources of irritation and perpetuate the inflammation.

At the outset such a damaged tissue is invaded by crowds of leucocytes which multiply rapidly and combine with the exudation to cause swelling and tension. By this means the circulation is further checked, nutrition suffers, and the area of necrosis may be extended.<sup>1</sup>

Moreover pyogenic cocci usually make their appearance, introduced either through a wound or derived from the blood. Many are destroyed by phagocytosis; but should their numbers be too great or should phagocytic activity be impaired, the invaders find in the clotted blood a favourable medium for growth and proliferation. The resulting chemical products in their turn intensify the inflammatory processes. Copious exudations of serum

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<sup>1</sup> In some forms of inflammation, such as that met with in gas gangrene, the bacillus *aërogenes* or the bacillus *perfringens* causes the development of much gas which aggravates the stasis. These microbes may also produce a condition of acidæmia which in turn favours their growth. *Lancet*, 1916, II., pp. 144, 1063; 1918, I., 208.

are poured out and in such serum float both the dead leucocytes that have perished in the struggle with the invaders and the fresh leucocytes which are continually hastening to the field of battle.

As a result of these changes the exudations gradually change into the fluid known as pus and tend to collect in an abscess cavity. Such pus, on the one hand, contains phagocytic cells and proteolytic enzymes, which assist the damaged tissue in its struggle for repair. On the other hand there are also present bacterial products which aggravate the inflammation. Moreover the proteolytic enzymes, while useful in destroying necrosed tissues, may at the same time be injurious to adjacent tissues of low vitality and actually cause their liquefaction. This explains how it is that pus often causes rapid destruction of the damaged tissues, which tissues in their turn supply nutriment to the micro-organisms and thus increase the formation of pus. Indeed the pus acts much as if it were a dead tissue in a state of decomposition and may cause as much irritation as would a foreign body. In other words, when once formed, pus feeds itself by liquefying the tissues round it—by perpetuating the very conditions in which it originated. Thus is established one of the most important Vicious Circles in pathology, and, generally speaking, pus must be evacuated before recovery can take place. The subject is further discussed in Chapter XX.

Capillary stasis is a prominent factor in frostbite, and results from a variety of causes such as cold, wet, exhaustion and prolonged standing, conditions which operate powerfully in trench warfare when soldiers have to stand in ankle-deep mud and slush. In the worst cases the blood-vessels may be so narrowed that the part affected is blanched. Such stasis and the associated lowered vitality allow a still greater fall of temperature which may end in gangrene.



When tight boots are worn there is further interference with the circulation, leading to swelling of the feet which in its turn increases the pressure of the boots.

Loughnane writes :

"In regard to boots a Vicious Circle develops. The wet leather shrinks and presses on the feet, thereby setting up traumatic inflammation and swelling, which swelling in turn increases the pressure from the boots."<sup>1</sup>

## VI. THE BLOOD

Disorders of the blood are of the first importance from the point of view of circular reactions since there is the closest interdependence between it and every other tissue.<sup>2</sup>

In health the blood is subject to daily and hourly variation as regards volume, composition, velocity, specific gravity, viscosity and so forth. Nevertheless it remains essentially the same, ever ready to supply nutriment, to remove waste, to protect against bacterial invaders and to neutralise injurious toxins. Its efficiency is maintained by a self-regulating mechanism which is in ceaseless operation and by means of which variations—chemical, physical, histological or biological—are rapidly remedied.<sup>3</sup> In other words variation evokes a beneficent reaction of the nature and strength required to restore the disturbed equilibrium. In disease this self-regulating mechanism is upset. Many reactions become excessive, overshoot the mark, and aggravate, in lieu of remedying, the disorder.

<sup>1</sup> *Lancet*, 1915, I., p. 803.

<sup>2</sup> Fuller details will be found in Vicious Circles associated with Disorders of the Blood, by J.B.H., *Practitioner*, 1916, I., p. 621.

<sup>3</sup> Achard, *Le Mécanisme Régulateur du Sang*, *Presse Médicale*, 1901, II., p. 133.

**Anæmia.** Various disorders originate in an impoverished supply of blood to organs and tissues. For instance, when the blood supplying the stomach is deficient in nutritive elements, the digestive fluids are deficient in potency, and in their turn keep the blood impoverished (**Plate III. f**). The sequence is much the same whether the disorder starts with anæmia or with the gastric disorder.

Robson Roose writes :

“ Blood in which some of the normal constituents are defective will not yield proper secretions, and thus the food will be liable to be imperfectly acted upon. In this way a Vicious Circle readily becomes established, inasmuch as the secretions themselves are dependent on the pabulum which the blood receives through the instrumentality of the assimilating organs.”<sup>1</sup>

Anæmia is frequently associated with fatty degeneration of the endothelial cells of the blood-vessels ; such degeneration may give rise to hæmorrhage which aggravates the condition.

Cabot writes :

“ To the fatty degeneration of the endothelial cells of the blood-vessels may be attributed the fact that in many anæmic conditions a general hæmorrhagic diathesis develops, which not infrequently combines with the primary disease to form a Vicious Circle.”<sup>2</sup>

In other cases hæmogenesis is paralysed. Blood impoverished of hæmoglobin cannot properly nourish bone-marrow ; hence blood-formation flags.

Buchanan writes :

“ Hæmorrhage is an obvious cause of blood loss or drain and is rapidly recovered from when sudden and profuse within limits. But continued and intermittent

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<sup>1</sup> Nerve Prostration, p. 492. Cf. also Buchanan, *The Blood in Health and Disease*, p. 164 ; Trousseau, *Clinical Medicine*, II., p. 383 ; V., p. 109.

<sup>2</sup> *Diseases of Metabolism and of the Blood*, p. 308.

and small hæmorrhages from the mucous surfaces may produce an anæmic state which may, from lack of recuperative power of the hæmogenetic tissues, become 'progressive' and fatal. It is quite conceivable that here a Vicious Circle is established, so that the impoverished state of the blood itself increases the tendency to hæmorrhage which originally produced it."<sup>1</sup>

Pernicious anæmia is probably due to paralysis of the hæmatopoietic organs, associated with diminished resisting power of the newly formed blood. These two factors—disordered blood formation and increased blood consumption—react injuriously on one another and often bring about a fatal issue.

Eichhorst writes :

"A Vicious Circle may be formed, when once disordered blood-formation or increased blood-destruction has given rise to marked anæmia of the common kind. For not only does the disordered blood-formation cause less blood to be formed, but the smaller quantity of newly formed blood also possesses less resistance and is therefore more readily used up. Thus the two components of disordered blood formation and increased blood consumption act injuriously on one another and combine to bring about a rapidly fatal issue."<sup>2</sup>

**Anhydræmia.** Anhydræmia such as is associated with cholera establishes some correlations which are closely connected with the fatality of the disease. As a result of the profuse evacuations, which may amount to eight or more pints within a short period, the blood sometimes loses more than half its fluid contents. Such loss is accompanied by a dangerously low blood-pressure, which sometimes falls as

<sup>1</sup>The Blood in Health and Disease, p. 164.

<sup>2</sup>Türk, *Klinische Hæmatologie*, II. (ii.), p. 379. Cf. also Pick and Hecht, *Clinical Symptomatology*, p. 494 ; *The Mayo Clinic* (1916), VIII., p. 620.

low as 50 mm. Hg.<sup>1</sup> This low pressure, combined with the increased viscosity and the swelling of the renal epithelium, leads to suppression of urine and to an accumulation of the toxins, which then perpetuate the disease. Thus the anhydræmia and anuria reciprocally aid and abet one another.

**Carbonæmia.** Determann has drawn attention to a complication of carbonæmia (i.e. an excess of CO<sub>2</sub> in the blood) due to the fact that excess of CO<sub>2</sub> increases the viscosity and *vice versa*. The reciprocation is thus described by Allbutt :

“Carbon dioxide is the most important of all the factors of viscosity, for the changes in viscosity by these gases (i.e. CO<sub>2</sub> and O) are less of the plasma than of the corpuscles. Hence in diseases of the heart and lungs a Vicious Circle is established of plus viscosity, plus resistance, plus CO<sub>2</sub>, and so round to plus viscosity again—a gyration which the heart may be unable, by increasing the pressure head, to break through.”<sup>2</sup>

This condition of carbonæmia is often the cause of death through a gradual interference with oxygenation. Ritchie thus refers to the process :

“Usually the act of dying is prolonged over a considerable number of hours and at the commencement there frequently appear disorders of respiration, which are indications either of oxygen-hunger or of the commencing accumulation of carbonic acid. . . . The essential point is a progressive failure of the heart and respiration in which each downward step in the capacity of one system is reflected in a corresponding downward

<sup>1</sup>In severe attacks Rogers found that the loss of fluid from the blood amounted to 64 per cent. *Cholera and its Treatment*, p. 149.

<sup>2</sup>Determann, *Die Viscosität des menschlichen Blutes*, p. 80. Cf. also Allbutt, *Diseases of the Arteries*, I., pp. 129, 130, 153 ; Hirschfelder, *Diseases of the Heart and Aorta*, p. 41.

step in the functions of the other. The supply of blood to the lungs by the heart is diminished, and frequently this leads to œdema of the organs. The coating of the alveolar epithelium with fluid interferes with the interchange of oxygen between the air and the blood ; the heart is thus supplied with a deficiently oxygenated blood, its inherent weakness is thus increased and at the same time the respiratory and cardiac centres in the medulla have their controlling functions perverted. The Vicious Circle established increases progressively in severity of effect, and finally the heart comes to a standstill."<sup>1</sup>

Other Circles associated with an accumulation of CO<sub>2</sub> are referred to in the Chapter dealing with respiratory disorders.

**Polycythæmia.** Some interesting correlations may be connected with polycythæmia, a condition in which the red blood disks may be increased to 10,000,000 in the cmm. or even more. The increased viscosity tends to produce some degree of blood stasis, and this in its turn favours the occurrence of thrombosis in the various viscera, thus further hampering the circulation. Again, retarded circulation and congestion in the blood-vessels of the lungs promote the development of chronic catarrhal changes, which induce cyanosis and throw extra work on the right side of the heart. Thus complex reactions are established ; the polycythæmia tends to impede the circulation, and the resulting blood stasis produced gives rise to a further polycythæmia.<sup>2</sup>

Another complication is sometimes observed in polycythæmia, a disorder in which increased formation and increased destruction of red disks act and react on one another.

<sup>1</sup> Pembrey and Ritchie, *General Pathology*, p. 759.

<sup>2</sup> Parkes Weber, *Quarterly J. of Medicine* (1908-9), II., p. 112.



Ward writes :

" The increase of red cells is the primary feature, so far as we can tell. This increases the viscosity of the blood and there is an increase of volume in order to relieve the viscosity. To this most of the symptoms would appear to be due. A further mechanical attempt of Nature to deal with the difficulty that she has initiated is increased destruction of red cells. This is shewn by the dark colour of the urine and the presence in it of urobilin. Unfortunately the stimulus of blood destruction inevitably leads to fresh blood formation, so that we very soon have a Vicious Circle. The total result seems usually to be inimical to the patient and the polycythæmia is steadily progressive. Arterial degeneration follows the increased blood-pressure, which depends in turn on the increased heart work necessary to drive round the body the highly viscous blood. This arterial affection often leads to death and the termination of the pathological process."<sup>1</sup>

There are a number of cardiac and respiratory diseases in which stagnation in the pulmonary capillaries and the associated deficient oxygenation give rise to polycythæmia and increased viscosity, which in their turn intensify the stagnation. Similar conditions, by throwing an extra burden on the heart, are apt to impair the efficiency of the eliminating organs and thus perpetuate the condition.<sup>2</sup>

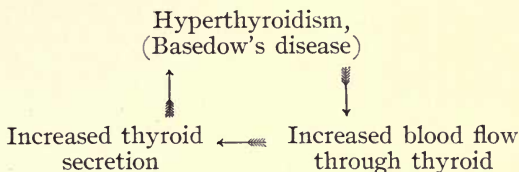
**Thyreo-Globinæmia.** Some pathologists believe that an injurious circular reaction may be established in cases of hyperthyroidism, due to the presence of thyreo-globulin in the blood. The increased quantity of blood passing through the thyroid causes an increased secretion of thyreo-globulin and this in its turn causes more blood to pass through the thyroid. Thus the thyroid epithelium is activated by its own product, which returns to it through the blood.

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<sup>1</sup> Bedside Hæmatology, p. 156.

<sup>2</sup> Ward, *l.c.*, p. 182.

Hirschfelder thus represents the sequence : <sup>1</sup>



According to Oswald an abnormally irritable nervous system is the principal factor that stimulates the thyroid and is in its turn stimulated by the thyroid secretion.<sup>2</sup>

Thyroid insufficiency may also establish a reciprocation in which subthyroidism, weakened peristalsis, constipation, toxæmia and progressive thyroid inadequacy constitute the factors. "Once the toxæmia is established, a Vicious Circle is formed."<sup>3</sup>

**Toxæmia.** Many circular reactions are created in the course of toxæmia. For instance, coprostasis in many persons is followed by the absorption of toxins, which weaken peristalsis and maintain the stasis.

E. von Ofenheim writes :

"The question is what is the effect of the stasis on the bacteria, and *vice versa* of the bacterial toxins on the stasis? It has repeatedly been proved that a Vicious Circle exists between them. Stasis causes

<sup>1</sup> Diseases of the Heart and Aorta, 1913, pp. 682-3, 689-91.

<sup>2</sup> Oswald (Zürich), Ueber den Morbus Basedow, *Correspondenz-Blatt f. Schweizer Aerzte*, 1912, p. 1144. Cf. also Wells, Chemical Pathology, p. 606.

<sup>3</sup> Hertoghe, Thyroid Insufficiency, *Practitioner*, 1915, I., pp. 54-5, 66. Cf. also McCarrison, The Thyroid Gland, pp. 138, 188.

bacterial poisons to be formed ; these poisons, again, have a paralysing effect on the intestines, and in this way add to the stasis."<sup>1</sup>

**Uræmia.** The term uræmia includes various complex disorders which supervene in the course of renal disease, and whose pathology is still obscure. But at least some of these disorders are due to the renal interference with the elimination of toxins which therefore accumulate in the blood and in turn aggravate the renal condition.

The exact nature of the poisons concerned is still unknown, but they are probably related to the antecedents of urea in the chain of metabolic processes.

Another view is that the renal cells under certain conditions may themselves manufacture poisonous substances, known as nephrolysins, which in their turn perpetuate the renal disorder.

Chauffard and Læderich write :

"There can be no doubt that certain alterations in the renal cells may give rise to toxic matters, which in their turn perpetuate these alterations and create a true Vicious Circle, the effect of which is a more or less indefinite continuance of the nephritis."<sup>2</sup>

Eclampsia may be similarly complicated.

Wells writes :

"A reasonable view of the cause of eclampsia is that it is initiated by the excessive products of metabolism thrown into the blood of the mother, both from the fetus and from her own over-active tissues. These cause injury to the kidneys, leading to a further

<sup>1</sup>*Proc. Royal S. of Medicine* (1913), VI. (i.), (*Alimentary Toxæmia*), p. 326.

<sup>2</sup>Brouardel and Gilbert, *Maladies des Reins*, p. 166. Cf. also Osler and Macrae, *System of Medicine*, III., 834 ; J. A. Kolmer, *Infection, Immunity and Specific Therapy*, p. 505.

retention, or injure the liver so that the normal metabolic processes of that organ (particularly oxidation) cannot be carried on ; or perhaps more often both liver and kidney as well as other organs are injured. In this way a Vicious Circle might be established and rapidly lead to an overwhelming of the maternal system with toxic products derived from both her own and the fetal tissues."<sup>1</sup>

**Uricæmia.** Injurious reciprocations may sometimes occur when excess of uric acid in the blood is caused by inadequacy of hepatic metabolism and associated with calculous nephritis.

For example, if from some cause or other the liver does not produce sufficient uricolytic enzyme to transform all the uric acid reaching it into urea, an excess of that acid passes into the blood and reaches the kidney, where some of it is deposited in the renal pyramids. In this way calculous deposits are liable to form and to give rise to a secondary chronic nephritis (néphrite lithiasique).

As a result of this nephritis there will be a lessened internal secretion, and this in turn causes lessened uricolytic enzyme in the liver.

Uricæmia also perpetuates itself as a result of increased viscosity of the blood due probably to the presence of an excess of urates in a colloid form. There results obstruction in the capillaries, leading to a further accumulation of the products of imperfect metabolism.

Gilbert writes :

"Capillary obstruction may in this way eventuate in an 'ill-burning fire,' in which the purin ashes of nitrogenous combustion (xanthin and uric acid) are

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<sup>1</sup>Chemical Pathology, p. 487. Cf. also Eden, Midwifery, pp. 112, 120, 123 ; Musser and Kelly, Practical Treatment, III., p. 634.

retained and accumulate to cause further obstruction, thus tending to form a *circulus vitiosus*.”<sup>1</sup>

According to Haig whose views, however, are by no means generally accepted, various other complications may be associated with an excess of uric acid in the blood, and these produce a condition known as collæmia. For example, collæmia and dyspepsia are reciprocally correlated.<sup>2</sup>

Further circular reactions such as those associated with cholæmia, hyperglycæmia will be described in other Chapters (Cf. Index).



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<sup>1</sup>“*Uric Acid*,” XIII., I., p. 22.

<sup>2</sup>Uric Acid as a Factor in the Causation of Disease, pp. 242, 405, 407.



# Chapter Five

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## THE RESPIRATORY SYSTEM



THE upper portion of the respiratory tract including the nose and throat will be dealt with in subsequent Chapters. We shall deal here with :

- I. The Lungs
- II. The Pleura
- III. The Bronchi

### I. THE LUNGS

**Pneumonia.** An injurious circular reaction is frequently met with in pneumonia, owing to the reciprocal embarrassment of the heart and lungs. The great strain imposed on the right ventricle is partly due to the impeded pulmonary circulation and deficient aëration and partly to the action of toxins, and frequently leads to dilatation and failure. When such failure supervenes, the weakened myocardium further impairs both pulmonary circulation and oxygenation, the primary trouble being thus re-enforced (**Plate IV. a**).

Fränkel writes :

“The heart thus gets into a *circulus vitiosus*, since the blood stasis causes a further diminution in the supply of oxygen on which the increased cardiac activity depends.”<sup>1</sup>

This process of reciprocation is especially grave when the heart is unsound to begin with ; then the patient is indeed *inter malleum et incudem*.

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<sup>1</sup> Lungenkrankheiten, p. 300. Cf. also *Lancet*, 1874, II., p. 682.

Pneumonia affords a good illustration of what may be called an "organic" Circle, i.e. one which arises from the interdependence of two organs. For a time the congested lung is vicariously aided by increased cardiac activity. But if too great a strain is imposed on the heart, this organ in its turn is weakened and reacts injuriously on the lungs which are finally undone by conditions created by themselves and for their own temporary advantage. A similar interdependence is present in all serious disorders both of the heart and of the lungs.

**Tuberculosis.** Pulmonary tuberculosis is complicated by a variety of injurious reciprocations which play an important share in the perpetuation and fatality of the disease. Only a few examples can be given here ; for further details reference may be made to a special article.<sup>1</sup>

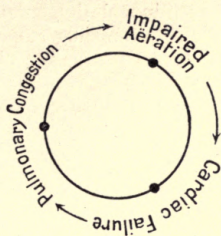
The lowered resistance which so frequently results from tubercular infection plays a great part in the extension of the disease. Such lowered resistance or hyper-susceptibility to fresh infection within certain limits is a protective reaction, which tends to repel infection and localize disease. Extreme hyper-susceptibility, however, causes grave toxæmia through excessive auto-intoxication, followed by a subnormal opsonic index and aggravation of the disease. In other words the machinery of immunization is paralysed, resulting in a further accumulation of toxins, these two factors abetting one another.

Thomson describes the process :

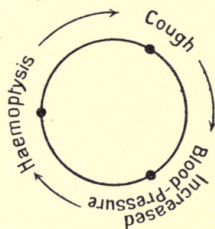
" In a large proportion of cases cure by spontaneous auto-inoculation does not take place. The reason for this is two-fold. The protective influence instead of being stimulated is paralysed, so that we have established a Vicious Circle which favours active progress of the disease. On the other hand, owing to the latent

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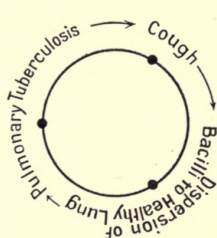
<sup>1</sup> Pulmonary Tuberculosis and its Vicious Circles, by J.B.H., *Practitioner*, 1914, I., p. 274.



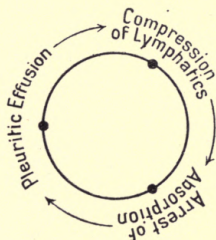
(a) PULMONARY CONGESTION



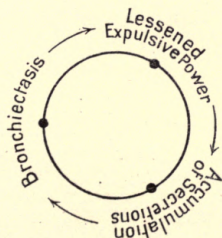
(b) HÆMOPTYSIS



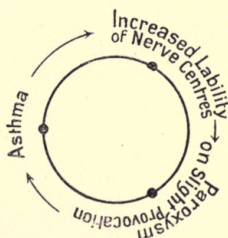
(c) PULMONARY TUBERCULOSIS



(d) PLEURITIC EFFUSION



(e) BRONCHIECTASIS



(f) ASTHMA

**Plate IV.—Circles associated with the Respiratory System.**

condition of the disease the auto-inoculation may not be sufficient to elicit any lasting immunizing response, in consequence of which healing does not take place, and the lesion remains quiescent, though ever ready in the presence of some favourable influence to burst into fresh activity."<sup>1</sup>

In many cases loss of vitality precedes the tuberculous invasion, but the further sequence of events is very similar. They are thus described by Muthu :

"Bad air and insufficient food, septic mouth and decayed teeth, adenoid growths and naso-pharyngeal catarrh, tonsillar enlargements and cervical and other glandular swellings, scrofulous diathesis and poor physical development, impaired nutrition and lowered vitality, all form a Vicious Circle which favours the entrance of tubercle and other germs in early childhood, when, if they do not develop and commence active mischief, they lie latent, and in after years produce pulmonary tuberculosis of adults."<sup>2</sup>

Another reciprocally acting disorder is associated with hæmoptysis and the increased blood-pressure caused by the act of coughing and by the anxiety accompanying the appearance of blood (**Plate IV. b**). Psychic conditions may send up the pressure by as much as 40 mm. Hg and the rise may be further increased by paroxysms of cough ; such increase tends to intensify the hæmorrhage.

Hare writes :

"In phthisical hæmoptysis there is in operation one of the most highly Vicious Circles in pathology—a Circle which is largely responsible for the profuseness and prolongation of the hæmorrhage. The intrapulmonary irritation of the effused blood causes cough : each act of coughing, like any other sudden exertion, causes rise of blood-pressure ; each rise of blood-

<sup>1</sup> Consumption in General Practice, p. 244. Cf. also *New York Medical J.*, 1918, II., p. 431.

<sup>2</sup> Pulmonary Tuberculosis and Sanatorium Treatment, p. 60.

pressure is apt to cause fresh hæmorrhage and so on over again, the Circle continuing to revolve in many cases until the loss of blood has been sufficient to reduce the blood-pressure materially and thus terminate the hæmorrhage. This natural cure of hæmoptysis was, at one period in the history of Medicine, imitated by physicians who resorted to venesection in this emergency—a somewhat expensive, but by no means irrational, imitation.”<sup>1</sup>

Pulmonary tuberculosis tends to extend by a process of auto-infection when a tuberculous patient re-inoculates himself with sputa discharged from a primary lesion in the lung. Cough forms one of Nature’s protective mechanisms since infected sputa are thus expelled. At the same time it is attended with much danger of diffusing infection, for tubercle-laden sputa, when loosened by cough, are frequently aspirated into healthy parts of the lungs and there set up fresh foci. Thus disease spreads from lobe to lobe, giving rise to fresh occasions for cough (**Plate IV. c**).

In some cases sputa, when loosened by cough, are swallowed and infect the alimentary tract. Thence the bacilli pass through the lymphatics and reach the lungs, where fresh foci are started and further materials for cough are produced.<sup>2</sup>

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<sup>1</sup> Food Factor in Disease, II., p. 97.

<sup>2</sup> Various mechanisms exist by which bacilli may be transported from one part of the body to another. For example, leucocytes may ingest bacilli and yet be unable to destroy them owing to an insufficient supply of intra-cellular antibodies. The bacilli may then be transported into neighbouring lymphatic vessels, and on the death of a leucocyte may escape into the tissues, like the Greeks from the wooden horse at Troy. In other cases a caseous tubercle may ulcerate and liberate bacilli into a blood-vessel. Fresh foci of disease may then be started in remote parts of the body.



Occasionally the incessant cough of a consumptive may rob him both of sleep and of *morale*, and this gives rise to great prostration. This like everything that exhausts a patient favours the progress of the disease. Again, severe cough not infrequently injures lung tissue in process of healing, thus increasing the irritation. Coughing then causes coughing.

In Judson's words :

"Coughing increases the irritation, and the irritation in turn increases the coughing. This is a Vicious Circle, and certainly suggests the intervention of reason and self-control."<sup>1</sup>

Pottenger also writes :

"Cough, by irritation, increases the tendency to cough, and by increasing secretion, increases the necessity for cough."<sup>2</sup>

The astonishing rapidity with which pulmonary cavities sometimes form and enlarge is due to the operation of circular reactions. An entire lung may at times be so completely destroyed that the bronchi open into a vast cavity bounded by little more than the pleura. The disintegration may be due to various causes. For instance, a mass of caseous tubercles may be discharged into a bronchial tube, leaving a cavity whose walls are in active tuberculous evolution. The larger the surface exposed to infection, the more rapidly does erosion proceed ; the cavity thus tends to grow excentrically. Again the accumulation of stagnant secretions greatly favours the multiplication both of the tubercle bacilli and of other pyogenic micro-organisms. These mixed infections accelerate the advance of the tuberculosis and tend to the further enlargement of the cavities.

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<sup>1</sup>International Congress on Tuberculosis at Washington (1908), II., p. 679.

<sup>2</sup>Pulmonary Tuberculosis, p. 271.

Camac Wilkinson writes :

"The ætiological diagnosis must take into account other infections, especially the common infections of the air passages. These infections favour tuberculosis and tuberculosis favours these infections. This Vicious Circle of tuberculosis and secondary or concurrent infections may play an important part even in the early stages of pulmonary tuberculosis, though, as a rule, those unfortunate accidental complications belong to a later stage of the disease."<sup>1</sup>

Laryngeal complications may also have an important influence. For example, the forcible propulsion of sputa against the vocal chords may abrade the laryngeal epithelium and inoculate the abrasions. This secondary focus may then become a fresh source of pulmonary infection. Dysphagia and insomnia are often aggravating factors.

Davis writes :

"When the larynx is involved a Vicious Circle occurs, in which the dysphagia, sleeplessness and cough produced by the painful lesion markedly increase the rapidity of the progression of the lung condition."<sup>2</sup>

In some cases of phthisis secondary dyspeptic disorders accelerate the progress of the disease.

Barbier writes :

"These visceral troubles add to the wretchedness of the sufferer. Not only are they caused by the tuberculosis, but they accelerate its progress, both by diminishing the power of resistance and by inducing other complications associated with tubercle. . . . Thus is established in all its mischievous correlations that Vicious Circle which so often complicates phthisis."<sup>3</sup>

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<sup>1</sup> Tuberculin in the Diagnosis and Treatment of Tuberculosis, p. 94. Cf. also *Practitioner*, 1913, I., p. 157.

<sup>2</sup> *Lancet*, 1913, II., p. 1112.

<sup>3</sup> Brouardel et Gilbert, *Maladies des Bronches et des Poumons*, p. 495. Cf. also *New York Medical J.*, 1918, II., p. 474.

These are a few of the conditions in which pulmonary tuberculosis tends to self-extension. Equally important are the social disabilities which result from and in turn feed the disease.<sup>1</sup>

**Atelectasis.** In weakly infants sudden death sometimes occurs as a result of atelectasis or pulmonary collapse, the fatal process being started by what at first appears to be a quite trifling catarrh. The rapid progress of the disease is due to the fact that collapse, once begun, supplies the cause for its further increase. On the one hand the accumulation of mucus tends to increase in proportion to the diminution in the amount of air entering the lungs ; on the other the increasing impurity of the blood, from imperfect aëration, impedes the muscular and nervous functions which would promote the expulsion of the mucus.

A pernicious factor is sometimes brought into operation in cases of dyspnœa when the lower ribs and even the lower end of the sternum are drawn inwards during the act of inspiration, instead of rising in the usual manner. The result may be a local pulmonary collapse, which by producing further dyspnœa may stimulate the respiratory activity, lead to greater drawing in of the ribs, and thus aggravate the collapse.<sup>2</sup>

**Œdema.** Important correlations are often present in soldiers who have been "gassed" by chlorine or other fumes during the war. According to Schäfer, who has carefully studied the condition, the irritant gas gives rise to acute congestion and obstruc-

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<sup>1</sup> Cf. Poverty and its Vicious Circles, by J.B.H., p. 40.

<sup>2</sup> Fagge and Pye-Smith, Text-Book of Medicine, I., p. 1057.  
Cf. also Allbutt and Rolleston, System of Medicine, III., pp. 89, 96.

tion of the pulmonary vessels associated with extensive œdema of the interstitial tissues of the lung. The exuded lymph may also escape into the alveoli, where it clots and thus intensifies the obstruction.

Schäfer writes :

" Presumably the œdema is secondary to the vascular obstruction, but even if this is so, it must set up a Vicious Circle by increasing the obstruction, and this again will increase the œdema, so that in cases of survival the œdematous condition must tend to increase, at any rate for some time."<sup>1</sup>

**Respiratory Inactivity.** A variety of conditions are met with in which oxygenation is impaired owing to defective respiratory activity, and such deficiency tends to be self-perpetuating. For example, in obesity the respiratory muscles and ribs are over-weighted with fat and unable to expand the chest efficiently ; moreover the thoracic cavity may be encroached upon by fatty cushions in the mediastina and by the fatty enlarged heart. The diaphragmatic pump may be unequal to forcing down the fatty viscera into the abdomen which is itself encroached upon by extensive and unyielding accumulations of fat. In brief, both the respiratory capacity of the chest and the respiratory movements of the lungs are diminished. All these conditions tend to shallow breathing movements and the shallower the respiration the less the assistance given to the return of venous blood to the heart and lungs. Further, the shallower the respiratory movements, the slower is the rate of oxidation ; the fat-forming substances are less perfectly burned up and are more largely deposited as fat, and thus the injurious sequence is renewed.<sup>2</sup>

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<sup>1</sup> *British Med. J.*, 1915, II., pp. 246, 801.

<sup>2</sup> Cf. Obesity and its Vicious Circles, by J.B.H., *Practitioner*, 1917, II., p. 164.

Feeble respiratory movements from any cause whatever tend to defective nutrition of the lungs, since such nutrition depends largely on adequate movements; hence defective expansion and impaired nutrition act and react on each other. In fact feeble movements of the chest walls are injurious in many directions. Even anæmia may be due to this cause.

“The patient lies in the Vicious Circle of a reduced activity of the respiratory centre, due to the anæmia it should help to dispel.”<sup>1</sup>

This conclusion, however, seems questionable; frequently anæmia has the opposite effect.

**Asphyxia.** Defective oxygenation as met with in asphyxia is often associated with self-aggravating conditions. The primary effect is increased respiratory activity which tends to compensate for the defect. If, however, such increased activity brings no relief the venosity of the blood increases, blood-pressure rises and the heart is slowed by the cardio-inhibitory centres in the medulla. Owing to the increased pulmonary obstruction *a fronte* and the increased supply of blood *a tergo* (due to inspiratory suction movements), the right heart becomes gorged with blood and eventually dilated and paralysed. This in turn leads to further venosity, which poisons the myocardium and tends to further dilatation, until at length the right auricle and ventricle lose all power of contracting. A similar process also involves the left side; but the progressive and dangerous dilatation of the right side plays the chief rôle, and contributes mainly to the fatal exitus.<sup>2</sup>

A slowly progressive form of asphyxia often marks the close of life, due to a gradual impairment of

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<sup>1</sup> Allbutt and Rolleston, System of Medicine, V., p. 723.

<sup>2</sup> Norris, Blood-Pressure, p. 26.



the respiratory function. The oxygen-content of the blood may fall to a mere trace, and induce a general narcosis resulting in frequent and shallow respirations which do but little to aërate the blood and gradually weaken until life ebbs away.

In the vast majority of cases the dying

“craving nought nor fearing,  
Drift on through slumber to a dream,  
And through a dream to death.”

## II. THE PLEURA

**Pleurisy.** A pleuritic effusion must, broadly speaking, be regarded as one of the natural defences of the organism in that it lessens the risk of adhesions and keeps the collapsed lung quiet. If tubercle bacilli happen to be present their dissemination is checked. On the other hand an effusion may do harm through interference with the lymphatic pump by which a constant circulation of fluid into, and out of, the pleuritic cavity is maintained. Deposits of fibrin may block the stomata and thus lead to an accumulation of the effusion. The condition then resembles that of a leaking ship whose pumps are plugged by sea-weeds pouring in with the water.

Further, the effusion may exert such pressure on the stomata and superficial lymphatics as to block the channels by which it should be absorbed; it may also make difficulties for itself by reducing or abolishing the respiratory movements on which the efficiency of the pump depends.<sup>1</sup> The improvement that so often follows paracentesis, even when only a small quantity of fluid is removed, is probably due to an arrest of this morbid process. The lymphatic pump has again begun to work (Plate IV. d).

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<sup>1</sup>West, *Lancet*, 1905, I., p. 787. Cf. also *New York Medical J.*, 1918, II., p. 519.

Another circular reaction is sometimes associated with an empyema when pus escapes into the respiratory tract and excites violent coughing. Such coughing, on the one hand, is an act of self-defence. At the same time the cough may cause such a profuse escape of pus as to flood the respiratory passages and actually cause death.

After an attack of pleurisy the pleural membrane often forms a *locus minoris resistentiæ*. In spite of recovery from the acute illness some residual lesion persists ; on trivial exposure the damaged pleura is attacked afresh, and each time the mischief increases, until the cumulative effect is considerable. The primary lesion by lowering resistance has led to recurrence ; recurrence has aggravated the primary lesion.

**Hydro-Thorax.** Many forms of respiratory and cardiac disease, especially in their later stages, are complicated by a general venous stasis, of which dropsy of the pleura forms one condition. The dropsy in its turn leads to further respiratory and cardiac embarrassment and thus establishes a self-perpetuating condition which frequently gives the *coup de grâce*.

### III. THE BRONCHI

**Bronchitis.** Circular reactions are frequently established in *acute* bronchitis, when the bronchial congestion obstructs the entrance of air, hinders the circulation through the lungs and consequently leads to defective aëration of the blood. In order to overcome this obstruction the right ventricle at first beats more vigorously and under favourable circumstances the circulation is satisfactorily maintained. But in severe attacks the heart frequently proves unequal to the extra burden imposed upon it. The right ventricle and auricle undergo dilatation, and this is followed by venous congestion

which spreads to the venæ azygos, the left superior intercostal and to the bronchial veins, thus further aggravating the bronchitis.

Other injurious correlations result from congestion of the coronary veins, since the nutrition of the whole of the myocardium is thus involved and the functional activity of both ventricles is impaired. Whether the weakness is felt *a tergo* or *a fronte* the bronchial congestion is increased and the bronchitis aggravated.

West thus describes the process as associated with the left ventricle :

“ As soon as the left ventricle fails, a fresh cause of pulmonary congestion is added, for there can be no greater obstruction to the circulation than a left ventricle which cannot drive the blood onwards. The pulmonary veins become congested, and the aëration of the blood is still further interfered with. This adds to the congestion of the right side, embarrasses still more the coronary circulation, and by further impairing the nutrition of the heart makes the left ventricle weaker still. The Vicious Circle thus established explains the rapid failure of the heart, which is so striking a feature in the later stage of many cases of bronchitis.”<sup>1</sup>

Similar complications arise in *chronic* bronchitis, when the compensatory hypertrophy of the right ventricle fails and is replaced by dilatation. The conditions then closely resemble those already described, the bronchial and cardiac disorders acting and reacting on each other.<sup>2</sup>

Chronic bronchitis and emphysema are frequently reciprocally related to each other. Not only does emphysema result from bronchitis, but it in turn also leads to bronchitis, for the wasting of the

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<sup>1</sup> Diseases of the Organs of Respiration, I., p. 129.

<sup>2</sup> Romberg, Krankheiten des Herzens und der Blutgefäße, pp. 156-7.

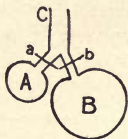
alveoli and consequent destruction of vessels causes obstruction to the circulation through the lungs. This is liable to be followed by dilatation of the right heart and systemic veins, and thus lead to further congestion of the bronchi.<sup>1</sup>

Bronchial congestion may sometimes be self-perpetuating owing to the associated paroxysms of coughing which increase the congestion. Probably also the act of coughing increases the bronchial secretions which in their turn must be removed by further coughing.

Lastly, bronchitis often supplies an example of a self-perpetuating disorder through the bronchial mucosa forming a *locus minoris resistentiæ*. In some persons each attack seems to lower resistance and thus predisposes to recurrence.

**Bronchiectasis.** Dilatation of the bronchial tubes occurs in a number of disorders, and when once it has been started tends to increase: dilatation breeds dilatation. One reason for this is that the greater the distention the less the force required for further distention, a paradoxical condition observed in a variety of conditions.<sup>2</sup>

Again in bronchiectasis there is a great tendency to the accumulation and retention of secretions. This is partly due to the destruction of the ciliated



<sup>1</sup> West, Diseases of the Organs of Respiration, I., p. 112.

<sup>2</sup> Such progressive dilatation is well illustrated by the following experiment. Suppose A and B to be two similar air sacs or lungs attached to a Y-tube C, A being blown up to a certain size and then clamped at *a*, while B is blown up to a larger size and similarly clamped at *b*. If the two clamps *a* and *b* are removed, B does not empty itself partially into A, but A partially empties itself into B and grows smaller.

epithelium, partly to the increased calibre and lessened elasticity of the tubes. The secretions then serve as a *nidus* for bacterial decomposition, which keeps up irritation, inflammation and secretion (**Plate IV. e**). Gases too are generated which exert a dilating pressure on the enfeebled walls.<sup>1</sup>

Scott describes the process as regards bronchial secretions and bacterial growth :

“ The bacteria present in chronic bronchitis are probably leading a saprophytic as well as a parasitic existence. The organisms present are living not only on the bronchial epithelium, but also on the bronchial secretions. These secretions are, in the first place, set up by repeated bacterial attacks on the epithelial cells, which are then kept actively secreting by the irritation of the toxins, a Vicious Circle being thus formed.”<sup>2</sup>

The weakening of the bronchial walls is aggravated by the frequent paroxysms of cough which result from the accumulated secretions ; these in their turn promote irritation and further secretion.

**Asthma.** Various hypotheses have been suggested to account for the phenomena associated with paroxysms of asthma, details of which will be found in every System of Medicine. One remarkable feature of the disorder is the defective character of expiration which is probably due to the fact that the expanded state of the chest gives the maximum patency to the bronchial tree. In other words the patient dare not expire fully.

Dixon and other writers, however, believe that the defective expiration is associated with a *circulus vitiosus* which operates through the following mechanism. A much greater force is exerted during inspiration than during expiration, which is mainly

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<sup>1</sup> M. Bruce, Principles of Treatment, p. 101.

<sup>2</sup> The Road to a Healthy Old Age, p. 179.



due to elastic recoil of the lungs. Consequently where there is an asthmatic broncho-constriction, air may be sucked through the constriction by the inspiratory force brought into play, while the elastic recoil is unable to expel the air sufficiently rapidly. Another inspiration therefore takes place before complete expiration, resulting in over-distention of the lung. This over-distention in its turn diminishes the force of expiration, i.e. the more the lungs are distended the feebler becomes the power of expelling air.

Dixon writes :

"In an attack of asthma due to broncho-constriction a Vicious Circle is established. The more the chest expands and the lungs are over-distended the weaker its powers of expiration become."<sup>1</sup>

Emphysema and bronchitis are frequent complications, being both cause and effect of asthma.

Latham writes :

"The amount of emphysema, the degree of bronchial catarrh, and the condition of the right heart are the most important factors in asthma. These complications all increase the severity of the asthmatic attacks, which in turn increase the severity of the complications, and so the patient lives in a Vicious Circle."<sup>2</sup>

Another injurious sequence may result from the gradual diminution of nerve control, so that a fresh attack supervenes on less and less provocation ; recurrence indeed is largely the result of previous attacks (**Plate IV. f**). The labile condition resembles that met with in epilepsy and in various habit spasms.

<sup>1</sup> *Proc. Royal S. of Med.* (1909), II. (iii.), (*Therapeutics*), p. 120. Cf. also Ewart, *British Med. J.* (1911), II., p. 1627.

<sup>2</sup> Short, *Index of Prognosis*, p. 182.

# Chapter Six

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## THE DIGESTIVE SYSTEM



DISORDERS of digestion are usually complicated by the operation of Vicious Circles. This liability arises in part from the interdependence of the chemical, physical and vital processes involved, in part also from the close sympathy between the gastrointestinal and other organs, even the most remote. Disease here breeds disease there, action and reaction being in continuous operation. This complication is largely accountable for the chronicity of dyspeptic disorders, some of which are most difficult to cure.

The following regional classification will be convenient :

- I. The Mouth
- II. The Œsophagus
- III. The Stomach
- IV. The Liver and Pancreas
- V. The Intestines
- VI. The Rectum and Anus

### I. THE MOUTH

Although every mouth is in some degree septic, it is not always that injurious reactions are provoked. The establishment of Vicious Circles depends on the number and pathogenicity of the invaders, as well as on the resistance offered by the host.

**Dental Sepsis.** If the teeth are not properly cleansed, particles of food, especially carbo-hydrates, undergo fermentative changes, with a production of dextrin and of lactic and other acids as end products.

These acids attack the lime salts of the enamel and dissolve the interprismatic cement, as a result of which the enamel breaks up and is removed mechanically. The solution of the lime salts of the dentine then follows, while the collagen of the dentine matrix is dissolved by proteolytic enzymes. By these processes cavities or pockets are formed in which lodge food and bacteria, leading to further fermentation and the production of more acid (Plate V. a).

The deposition of lime salts from the saliva in the form of tartar may also establish morbid correlations by setting up gingivitis and causing recession of the gums from the tooth, leaving the neck and fang exposed. The exposed fang in its turn receives a coating of tartar, which excites further irritation and recession.<sup>1</sup> Thus the presence of dental calculus is self-perpetuating. In course of time the tooth loosens and drops out.

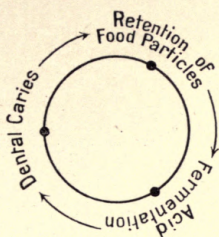
An artefact sepsis is sometimes dependent on careless fillings, ill-fitting crowns, gold caps and tooth-plates. These frequently lead to caries by friction against the teeth, and thus promote an increase of the sepsis which rendered them necessary.<sup>2</sup>

The teeth, however, are not merely isolated structures with functions independent of those of other organs ; on the contrary, they have anatomical, physiological and pathological affinities with the rest of the body. Hence it is that dental sepsis may provoke such various troubles as gastrointestinal catarrh, pneumonia, infectious endocarditis, iritis or osteo-myelitis, and such secondary disorders react on the teeth, cause and effect aiding and abetting each other.

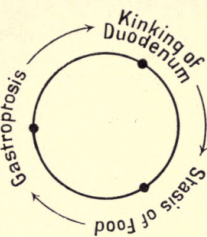
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<sup>1</sup> *Lancet*, 1894, I., p. 467.

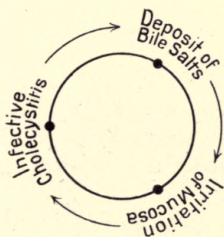
<sup>2</sup> *British Med. J.*, 1914, I., pp. 1244, 1301.



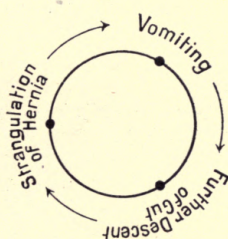
(a) DENTAL CARIES



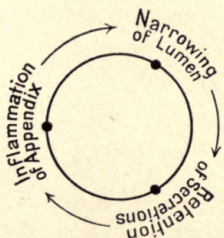
(b) GASTROPTOSIS



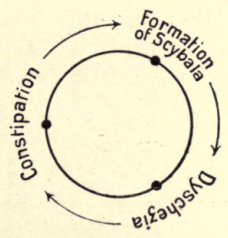
(c) CHOLECYSTITIS



(d) HERNIA



(e) APPENDICITIS



(f) CONSTIPATION

Plate V.—Circles associated with the Digestive System.

Coleman writes :

“Diseased teeth or their sequelæ such as the constant swallowing of bacteria and their toxins . . . . may involve the entire gastro-intestinal tract and its annexes, so that Vicious Circles become established and conditions produced which at first sight may appear to bear but little connection with the teeth.”<sup>1</sup>

According to some writers caries may hinder the development of the maxillæ. Such imperfect development in its turn promotes caries and malnutrition, notably in early life.

Goadby writes :

“Among children we find impaired nutrition and with it impaired growth ; with this, again, badly developed maxillæ and thus the Vicious Circle is complete.”<sup>2</sup>

Even so common a trouble as persistent toothache may provoke reciprocal reactions, when it produces insomnia, lowers the neuron threshold and increases sensitiveness to pain. Here is an illustration of the law that attention and hyperæsthesia intensify each other.

**Oral Sepsis.** Dental sepsis necessarily implies oral sepsis. But the converse does not always hold good, since the mouth may be septic even when the teeth are sound. The commonest oral disorder is doubtless pyorrhœa alveolaris which perpetuates itself locally by the formation of pockets, and also produces similar constitutional effects as does dental sepsis, lowers the resisting power of the tissues and thus facilitates further infection of the gums.<sup>3</sup>

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<sup>1</sup> *St. Bartholomew's Hospital J.*, 1909, II., p. 37.

<sup>2</sup> *British Med. J.*, 1904, II., p. 440.

<sup>3</sup> Similar injurious reactions occur amongst the lower animals with occasionally fatal effects. *British Med. J.*, 1914, I., p. 1246. Cf. also Colyer, *Chronic Periodontitis*, p. 46.



Great attention has been paid to these correlations of recent years, and a variety of disorders have been attributed to them.<sup>1</sup>

Payne writes :

“The chronic nature of the complaints associated with the alimentary toxæmia is largely due to the fact that a Vicious Circle is established. When once oral sepsis has led to gastro-intestinal trouble the oral sepsis itself may be kept alive by the secondary complaint.”<sup>2</sup>

According to Pickerill oral sepsis has much to do with weakening of the glosso-pharyngeal-chorda tympani-vagus reflexes which govern salivary and other secretions, and thus favours the proliferation of organisms and the production of toxins.

Pickerill writes :

“There is set up an extremely strong Vicious Circle. Diminished oral stimulation produces oral stasis and sepsis initially. These in turn produce gastric and intestinal sepsis, thus giving rise to toxins, which being absorbed still further increase oral sepsis and diminish taste-perception by causing intestinal dilatation, which increases toxic absorption. And so the cycle goes on getting stronger and stronger until the patient's alimentary system can no longer resist the strain or perform its function.”<sup>3</sup>

The conditions here described are often met with in exhausting illness when sordes accumulate and interfere with mastication and digestion. The same is true of aphthous stomatitis where the taking of

<sup>1</sup> Burchard and Inglis, *Dental Pathology and Therapeutics*, pp. 38, 62.

<sup>2</sup> *Lancet*, 1913, II., p. 1236 ; 1906, I., p. 509. Cf. also *Proc. Royal S. of Med.* (1913), VI. (i.), (*Alimentary Toxæmia*), p. 275.

<sup>3</sup> *Dental Caries and Oral Sepsis*, p. 304. This Circle is illustrated on p. 299. Cf. also *Lancet*, 1909, I., p. 1822.

food causes difficulty and pain, and thus leads to increased debility.

## II. THE ŒSOPHAGUS

**Œsophageal Pouch.** The so-called œsophageal pouch is a diverticulum or hernia of the posterior or postero-lateral wall of the pharynx into the adjacent loose areolar tissues. As food enters and distends the sac, the œsophagus below is apt to be compressed, causing more food to enter the sac and increasing its size. Moreover the pouch, as it grows, may come to form the direct continuation of the pharynx, and this again causes more food to enter. As a result of this retention of food, decomposition is liable to occur, and this leads to inflammation, spasm and increased retention.

Starck writes :

“ In the treatment of dilatation of the œsophagus the most important thing to bear in mind is the prevention of inflammation, as when this occurs a Vicious Circle is established. Inflammation is followed by spasm, spasm by obstruction, and obstruction by further inflammation.”<sup>1</sup>

Unless the diverticulum can be cured, death may result from slow starvation.

**Œsophagismus.** Spasmodic stricture or œsophagismus is not uncommon in neurasthenic individuals and may be of purely psychical origin. The more the victim fears the advent of the spasm the more likely is its advent, and *vice versa*. The condition illustrates the spasmophilia which characterises the emotional temperament.

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<sup>1</sup> Die Divertikel und Dilatationen der Speiseröhre, abstracted in *British Med. J.*, 1911, II., p. 1599. An excellent diagram of an œsophageal pouch is given by Schmidt, *Krankheiten der oberen Luftwegen*, p. 726.

## III. THE STOMACH

Reciprocity of disorder in connection with the stomach is of frequent occurrence. A few striking examples may be referred to.<sup>1</sup>

**Chronic Gastritis.** The various gastric functions involved in digestion are so intimately associated that impairment of the one involves the others. Deficiency of secretion spells deficiency of absorption and of peristalsis, and *vice versa*. It matters little which function suffers first ; when the chain is dragged the links must follow. In Allbutt's words : " the stomach falls into the Vicious Circle of doing as ill for itself as for other parts of the body."<sup>2</sup>

Ewald describes the sequence :

" Defective muscular movement reacts by diminishing the activity of absorption, defective absorption leads to stasis in the venous area, and this again to

<sup>1</sup>The term Vicious Circle has sometimes been applied to disorders in which there are no reciprocal processes in operation, and which, therefore, do not fall under the definition given in the Introduction. Such a disorder is occasionally established after a gastro-enterostomy, when the gastric contents pass through the anastomosis and return to the stomach through the duodenum, or else pass first into the duodenum and return to the stomach through the anastomosis.

Trendelenburg also describes a " Vicious venous Circle," which may complicate varicose veins of the leg where the valves are incompetent. After passing through the saphena vein into the veins which connect the superficial with the deep veins, the blood flows into the popliteal and femoral veins back into the saphena vein, thus flowing from, instead of towards, the heart and completing the circuit. Da Costa, Modern Surgery, p. 409.

<sup>2</sup>Allbutt and Rolleston, System of Medicine, III., p. 388.

injury to secretion, so that a Vicious Circle is created. You can easily perceive that it is quite the same at whichever end you begin this chain; whether the first trouble is secretory or motor, or absorption is affected, the same results must always follow, unless the failure of the one function can be compensated for by the stronger action of another, by which the disturbance might be rectified."<sup>1</sup>

Chronic gastritis is usually associated with some degree of gastrectasis, especially when there has been prolonged retention of food. Such retention leads to decomposition and fermentation, as a result of which enormous quantities of gas may be generated, with the result that the stomach yields more and more to the pressure. The retention and dilatation thus aid and abet each other.<sup>2</sup> Such gastrectasis is frequently associated with stenosis of the pylorus due to cancer.<sup>3</sup>

In many cases the gastrectasis seems to excite boulimia which then further increases the gastric dilatation.

M. Bruce writes :

"The subjects of chronic gastric catarrh, associated with a degree of dilatation of the stomach from atony of the wall develop an excessive appetite and eat largely. A Vicious Circle is established, and the morbid condition aggravates itself automatically."<sup>4</sup>

Acute gastrectasis associated with paralysis of the walls and retention of gases and secretions is

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<sup>1</sup> Diseases of the Digestive Organs, II., p. 484. Cf. also Cohnheim, General Pathology, III., p. 857; Rosenheim, Krankheiten der Speiseröhre und des Magens, p. 96.

<sup>2</sup> Cohnheim, General Pathology, III., pp. 859, 862. Cf. also *British Med. J.*, 1902, II., pp. 1390, 1393.

<sup>3</sup> Vierordt, Medical Diagnosis, p. 345.

<sup>4</sup> Principles of Treatment, pp. 471, 458-9.

sometimes seen in severe illness and is an indication of great danger. Here also the several factors intensify each other.<sup>1</sup>

**Gastroptosis.** Some degree of gastroptosis is invariably associated with gastrectasis, owing to the prolonged retention and increased weight of the ingesta. But the displacement becomes aggravated when the loaded stomach sinks so low as to produce a duodenal kink, since such kink further hinders the escape of the gastric contents.<sup>2</sup> The gastroptosis and gastrectasis then intensify each other, and the stomach may assume enormous dimensions.<sup>3</sup> The mechanical displacement aggravates the disorder to which it was due (Plate V. b).

In some cases the distended stomach forces down the intestines in such a way that the mesenteric blood-vessels and nerves form a tight band across the duodenum and prevent any gas from passing. The tighter the band the greater the accumulation of gas and *vice versa*.

Barnard describes the process :

“ In some cases of acute paralytic dilatation of the stomach it would appear that the small intestines have been driven downwards and backwards into the pelvis by the enlarging organ, and that the mesentery has been drawn tightly across the duodenum. In such cases, in addition to the stomach, the duodenum is distended to the point at which it is crossed by the mesentery, and a Vicious Circle is thus established.”<sup>4</sup>

<sup>1</sup> Krehl, Basis of Symptoms, p. 253. Cf. also Keen, Surgery, III., p. 949.

<sup>2</sup> Billings, Diseases of the Digestive System, p. 271. Cf. also *British Med. J.*, 1902, II., p. 1397 ; *Lancet*, 1911, II., p. 215.

<sup>3</sup> Such a stomach may contain as much as seventy pints.

<sup>4</sup> Allbutt and Rolleston, System of Medicine, III., p. 769.



A curious complication may occur owing to the fact that any imbibed liquid does not reach the intestines, and consequently can neither be absorbed nor quench thirst. Hence the unallayed thirst causes more drinking, producing increased distention of the stomach, increased obstruction, and increased difficulty in satisfying thirst. Thus a paradoxical condition may arise in which a person is tormented with thirst, although his stomach contains several pints of fluid.<sup>1</sup>

**Hyperchlorhydria.** A circular reaction is sometimes present in hyperchlorhydria, a condition which is present in various forms of dyspepsia.

Thus Sippy writes :

“ In true hyperchlorhydria a Vicious Circle is established. Excessive gastric secretion is excited by the presence of food. The excessive acidity irritates the nerves of the gastric mucosa and the glands respond to the normal stimulus, food, by pouring out excessive secretion, which renders the gastric mucosa irritable.”<sup>2</sup>

This disorder, however, is much more serious when it is complicated and aggravated by the presence of pyloric spasm.

During normal digestion the pyloric sphincter remains for the most part closed, relaxing at intervals to allow the passage of acid chyme, and then closing again under the influence of the duodenal reflex. In cases of hyperchlorhydria, however, this mechanism is liable to be disturbed. The usual alternation between opening and contraction of the sphincter is then replaced by persistent spasm, followed by retention of the gastric contents. Such retention then provokes further hyperchlorhydria and com-

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<sup>1</sup> Virchow, *Archiv*, CLVI. (1899), p. 306.

<sup>2</sup> Musser and Kelly, *Practical Treatment*, III., p. 367. Cf. also von Noorden, *Zeitschrift f. klin. Medizin* (1904), LIII., p. 7.

pletes the round. In fact hyperchlorhydria, pyloric spasm and gastric stasis may form an obstinate concatenation of disorders.<sup>1</sup>

Mathieu and Roux write :

“Reichmann’s syndrome presents a remarkable example of a pathogenic Vicious Circle. The following are the component factors : persistent pain, hyper-secretion of gastric juice, hyperchlorhydria and stasis. The spasm of the pylorus has been proved to be the principle cause of the pain and gastric stasis. The stasis in its turn perpetuates the hyper-secretion, and this again perpetuates the spasm. In a considerable number of cases there is an ulcer at, or near, the pylorus which causes the pain, spasm and hyper-secretion. In fact the hyper-secretion and stasis prevent the healing of the ulcer.”<sup>2</sup>

**Gastric Ulcer.** The sequence of hyperchlorhydria, spasm and stasis referred to above is met with in many cases of gastric ulcer. Ulcers may also occur apart from any such spasm, in which case the hyperchlorhydria and ulceration perpetuate each other. Doubtless the presence or absence of spasm depends on the degree of acidity, on the situation of the ulcer and on the state of the nervous system.

Roux describes the morbid sequence :

“The hyperchlorhydria which is so constantly present in cases of gastric ulcer, may be due to reflex irritation. On the other hand clinical observations seem to indicate . . . that in many cases the hyperchlorhydria precedes the ulcer. We may therefore conclude] that the hyperchlorhydria promotes the formation of the ulcer, while, on the other hand, by

<sup>1</sup> Pyloric spasm may also perpetuate a state of hyperchlorhydria by preventing any reflux of alkaline pancreatic juice. *Lancet*, 1915, I., p. 290.

<sup>2</sup> Pathologie Gastro-Intestinale, Series I. (1909), p. 149. Cf. also *Practitioner*, 1915, I., p. 240.

means of a Vicious Circle, the ulcer once formed increases the hyper-secretion and the hyperchlorhydria. This concatenation of phenomena may well explain the tendency of the ulcer to become chronic."<sup>1</sup>

The adhesions which so frequently form round the base of the ulcer are doubtless a provision of Nature to prevent perforation, or to localise the subsequent peritonitis, should the ulcer give way. Such adhesions, however, are by no means an un-mixed blessing, since they cause fixation of the ulcer, prevent its undergoing the contraction which is so necessary for repair, and thus delay recovery.

**Acute Gastritis.** Acute gastritis is sometimes brought on through dietetic indiscretion, as for instance when unwholesome or excessive food has been taken. The result may be acute inflammation which checks digestion, and is followed by severe flatulence and fermentation which perpetuate the gastritis.

Ewald describes the sequence :

"The impaired secretion and peristalsis give rise to inflammation of the mucosa, which in its turn further checks the gastric secretion and thus establishes a Vicious Circle *in optima forma*. Putrefactive and fermentative decomposition supervenes as an aggravating factor."<sup>2</sup>

**Aërophagy.** The habit of aërophagy or wind-swallowing as met with in neuropaths may be a self-perpetuating disorder. In some cases the eructations consist of gas which has never passed beyond the œsophagus ; usually they are brought up from the stomach. The habit probably begins with an

<sup>1</sup> Debove, Achard and Castaigne, *Maladies du Tube Digestif*, I., p. 205.

<sup>2</sup> Eulenburg, *Real-Encyclopädie der gesammten Heilkunde*, XIV., p. 258.

attack of flatulence which the sufferer discovers he can relieve by voluntary belching. The forced belching, however, while of some benefit, really aggravates the discomfort, and produces the sensation of an object lying just behind the larynx. He therefore belches again and the habit may thus be indefinitely repeated. Indeed some persons are occupied all day long in rhythmic air gulping and eructation so as to be scarcely fit for decent society. More air may be swallowed than is expelled by eructation so that the stomach grows more and more distended.<sup>1</sup>

Mathieu and Roux describe the process :

“ Severe aërophagy generally shews itself in neuroaths, and results from their predisposition and nervous temperament. Moreover in its turn it aggravates the neurasthenia or one or other symptoms of that disorder by means of one of those Vicious Circles that are so common in neuropathology. Many of the sufferers are inclined to worry about trifles or are subject to definite phobias. They dread the approach of an attack of aërophagy, and that is precisely what is likely to provoke a recurrence. Thus they tend to grow more and more neurasthenic.”<sup>2</sup>

Other gastric disorders associated with neuroses are dealt with in chapter three.

**Parasitic Infection.** Perversion of the appetite is sometimes produced, particularly in children, by the presence of the *ascaris lumbricoides* or one of the species of *ankylostoma duodenale*, the perverted appetite taking the form of pica or geophagy. Earth or even fæces may be eaten, and as the ova

<sup>1</sup> Air gulping occurs frequently in horses and cattle and may result in fatal wind-colic. The stomach may be so distended as to produce total obstruction. Wyllie, *Edinburgh Hospital Reports* (1895), III., p. 21.

<sup>2</sup> Pathologie Gastro-Intestinale, Series I. (1909), p. 185.

are excessively common in the soil this indulgence often increases the infection. In other words the infection excites the earth hunger and this perpetuates the infection.

Geophagy is very common in Egypt and other countries where embryos and ova swarm in the soil. A single female ascaris is said to discharge 60,000,000 ova.

Another self-perpetuating process may be connected with the presence of the *tænia solium* in the small intestines when the parasite sets up anti-peristalsis. Through this mechanism larvæ may be returned to the stomach where the acid juice dissolves the larval case and allows the parasite to regain the intestines. Thus a form of auto-infection may take place.

The same sequence may occur in the life-history of the *hymenolepis nana*, another tape-worm that is prevalent in Italy.

#### IV. THE LIVER AND PANCREAS

The liver is closely associated with the other digestive organs both in health and disease. In its various disorders there is frequently a mutuality of cause and effect whose influence we have now to study.

**Congestion.** There is some degree of hepatic derangement in almost all forms of dyspepsia. In slight attacks such as those included under the term biliousness the disorder is functional and rapidly subsides.

In severe attacks there may be actual congestion resulting from, as well as aggravating, the disordered gastric and intestinal condition.

Lauder Brunton thus describes the sequence of events :

“Indiscretion in eating or drinking disturbs the digestive processes in the stomach and intestines ;



the products of imperfect digestion or of decomposition in the intestine being absorbed into the veins pass to the liver ; they may there induce an obstructed flow through the hepatic capillaries ; the venous blood returning from the stomach and intestines will no longer be able to find an easy passage into the general circulation, and venous congestion of the stomach and intestines will be the result. Such venous engorgement as this will interfere with gastric and intestinal digestion, and this again will react upon the liver. Here, then, is a Vicious Circle which it is necessary to break.”<sup>1</sup>

Congestion of the liver may also be associated with heart disease and in turn aggravate such disease. In the early stages of heart failure the liver may, owing to the interdependence of the two organs, give some relief to the heart by allowing some of the blood that would have overtaxed the cardiac chambers to accumulate in the capacious hepatic blood-vessels. But the hepatic functions and those of the portal viscera generally are apt, in their turn, to become deranged, and as a further consequence the cardiac failure is increased. Indeed death may occur as a result of a process which originally benefited the heart. Here is a good example of an organic Circle in which two interdependent organs injuriously affect each other.

M. Bruce thus describes the later stages of such failure :

“ The day of reckoning has come. Bad has led to worse. A Vicious Circle is established : the penalty attending the accommodating process and the vicarious action by which one organ relieves another organ in distress. This result appears at first sight to be at variance with the self-adjusting, self-righting properties of the body. Instead of spontaneously recovering, one diseased organ is found upsetting other organs to its

<sup>1</sup> Disorders of Digestion, p. 25.

own further detriment, if for its own temporary relief. This must apparently be accepted as a primary or essential physiological necessity in connection with all complex organisations and structures. In physiology, just as in finance, mutual accommodation is invaluable and indeed indispensable, and it is often permanently as well as temporarily successful inasmuch as it affords time and opportunity for recovery of position. But the relation on which the employment of it depends, namely, the mutual dependence of associated interests, is liable to land us in widespread and hopeless ruin. In a word, Vicious Circles are one of the penalties that have to be paid for the many advantages of organisation. The number and area of the Vicious Circles set up by disease are practically unlimited. The instances just given are striking examples, but a similar order of widening and deepening disturbances may be traced into all the great systems in disease of any moment : arrest of digestion, alimentation and elimination ; disorder of sleep ; interference with exercise and its attendant benefits, and so on."<sup>1</sup>

**Biliary Calculus.** The processes concerned in lithiasis are well illustrated by the formation of a biliary calculus, where the ætiological factors include the stagnation of bile, bacterial infection and catarrh of the biliary passages. A nucleus of cholesterol is deposited, round which collect epithelial cells and bilirubin calcium. Such a nucleus, even though small, acts somewhat like a foreign body, causing irritation and desquamation of the mucosa, the products of which adhere to, and increase the size of, the nucleus. From increasing size result in-gravescent irritation and catarrh, and so the process is accelerated (**Plate V. c**).

MacCallum describes the sequence :

"All gall-stones contain a great deal of organic material derived from desquamated epithelial cells and

<sup>1</sup> Principles of Treatment, p. 189.

coagulated albuminous matter as well as pigment. Many of them contain bacteria, and are formed in infected bile and within a gall-bladder which is inflamed, because in this Vicious Circle the presence of the stone aids in giving a foot-hold to bacteria, while they in turn, through the inflammation they set up, aid in the growth of the stone.”<sup>1</sup>

In some cases of cholelithiasis the calculus blocks the outlet of the gall-bladder like a ball-valve. Hence results an accumulation of bile, and the greater the accumulation the more tightly is the outlet plugged.

Cholecystitis may also be self-perpetuating when the inflammation of the mucosa extends to the cystic duct and narrows its lumen. Such narrowing is then apt to lead to retention and putrefaction of bile, followed by increased narrowing, and so the process continues until obstruction is complete.

Infective catarrh of the bile-ducts appears at times to excite a similar condition of the pancreatic ducts which then in turn reacts on the bile-ducts.

Musser and Kelly write :

“ Infective cholangitis constitutes a Vicious Circle with chronic pancreatitis. The infection from the biliary tract involves the pancreas which in turn becomes swollen and indurated and creates more or less obstruction to the passage of bile down the common bile duct, which in two-thirds of all cases runs for a short distance through the head of the pancreas before piercing the posterior wall of the duodenum. As a result of this obstruction the infective phenomena in the biliary duct are furthered and each condition become mutually disadvantageous to the other.”<sup>2</sup>

Pancreatic calculi and retention cysts develop in

<sup>1</sup>Text-Book of Pathology, p. 392. Cf. also Rolleston, Diseases of the Liver, p. 606.

<sup>2</sup>Practical Treatment, IV., p. 697.

much the same way as do similar conditions in the liver.

**Hepatic Insufficiency.** In certain diseases such as acute yellow atrophy the hepatic functions may be gravely upset by toxic agents which endanger the structure of the hepatic cells. These cells may even undergo a process of self-digestion or autolysis resulting in the suppression of all the hepatic, especially of the antitoxic, functions. The result is a cumulative increase of the toxic or cholæmic condition. The toxæmia and arrested antitoxic activities aggravate each other and a fatal issue is not infrequent.

Monod writes :

"By hepatism we mean a diathesis, hereditary or acquired, characterised by inadequacy of the liver cells. A Vicious Circle is thus created, the toxins set free reacting in turn on the cells of the liver. Disturbance of the intra-hepatic circulation follows, and, in sequence to this, there arises a like disturbance of circulation in the bowel."<sup>1</sup>

Wells has drawn attention to the reciprocal effect on each other of cholæmia and biliary obstruction.

"Since bile salts cause hæmolysis, and since in even hæmatogenous jaundice they enter the blood, it can readily be seen that in this way an increased formation of bile-pigment may be incited which leads to further obstruction to the outflow of bile from the liver, and a Vicious Circle may thus be established."<sup>2</sup>

This sequence of events, however, by no means always occurs.<sup>3</sup>

One form of cholæmia (acholuric jaundice) is caused by rapid blood destruction. This is fol-

<sup>1</sup> *Proc. Royal S. of Med.* (1913), VI. (i.), (*Alimentary Toxæmia*), pp. 180, 267.

<sup>2</sup> *Chemical Pathology*, p. 445.

<sup>3</sup> Parkes Weber, *Practitioner*, 1916, II., p. 145.

lowed by polycythæmia and this in its turn by further blood destruction.<sup>1</sup> The condition resembles that described under polycythæmia (p. 65).

According to various writers eclampsia may at any rate be partly dependent on hepatic insufficiency. Probably there is reciprocation of cause and effect between hepatic and renal insufficiency, not only in eclampsia but in various toxic conditions. The condition has already been referred to on p. 68<sup>2</sup>

Other hepatic and renal correlations may be established when excess of uric acid in the blood has been caused by inadequacy of hepatic metabolism and is associated with calculous nephritis. For example, the liver under certain conditions fails to produce sufficient uricolytic enzyme to transform all the uric acid reaching it into urea. Consequently the excess of uric acid passes on to the kidney, where some of the acid may form calculous deposits in the renal pyramids, and give rise to a secondary chronic nephritis. The result will be a lessened internal renal secretion, and this in turn causes lessened uricolytic enzyme in the liver.

**Hepatoptosis.** Ptosis of the liver is closely associated with general visceroptosis, the symptoms of the latter largely obscuring those of the minor displacement. Under normal conditions the visceral surface of the liver rests on a shelf formed mainly of the right kidney, colon, stomach and the first section of the duodenum and pancreas, this shelf being held in place by the abdominal muscles. The posterior portion of the liver is attached to the diaphragm by the meso-hepar, consisting of blood-vessels, connective tissue and peritoneum.

<sup>1</sup>Ward, *Bedside Hæmatology*, pp. 157, 220.

<sup>2</sup>Wells, *Chemical Pathology*, p. 487. Cf. also Osler and Macrae, *System of Medicine*, III., 899.



Under various circumstances, however, the abdominal walls become greatly stretched and weakened, with the effect that the support usually given to the shelf is lost. The liver consequently tends to rotate on the meso-hepar and to fall downwards and backwards. The greater the relaxation of the abdominal walls the greater the tendency to hepatoptosis and *vice versa*. The sequence may also originate in excessive constriction of the thorax by the corset which dislocates the liver. Displacement of the liver in its turn involves some degree of interference both with the circulation of blood and of bile, and such interference must tend to increase the weight of the organ.<sup>1</sup> All the factors are aggravated by the almost invariably associated general visceroptosis.

The increased weight, stretched ligaments and disordered functions of a displaced liver are apt, as in the case of other displaced organs, to give rise to vague aches and pains, which, especially in neurotic persons, keep the attention constantly fixed on the displacement. Thus there is a constant repercussion between exaggerated sensitiveness, emotivity and consciousness which frequently ends in chronic invalidism. "A Vicious Circle is apt to be established owing to the inherent state of emotivity of the neurasthenic."<sup>2</sup>

## V. THE INTESTINES

Some of the circular reactions alluded to in connection with the stomach reappear *mutatis mutandis* in connection with the intestines. But a number of

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<sup>1</sup> Experimental evidence of Biliary Obstruction in Floating Liver is given by Steele, *University of Pennsylvania Med. Bulletin* (1902), XV., p. 424

<sup>2</sup> Mott, *Lancet*, 1918, I., p. 128. Cf. also Norris, *Blood-Pressure*, p. 180.

fresh examples result from the peculiar anatomical relations of the latter.

One of the chief requirements for the health of an organism is that its conduits be free from obstruction. Everywhere does obstruction cause disorder, which varies from temporary discomfort to grave disease or even death.<sup>1</sup> The healthy organism possesses numerous mechanisms for the removal of such obstruction, such as vomiting, increased peristalsis and abdominal straining, and in minor degrees of disorder these mechanisms prove highly efficient. They are, however, of limited potency ; they often fail of their purpose, and it is a remarkable fact that such failure usually aggravates the primary disorder. Obstruction may be due to defective propulsive power, to narrowed conduits or to inspissation of solid or liquid matters in transit ; numerous examples of these conditions occur in connection with the digestive tract.

**Spasm.** Excess of peristalsis sometimes takes the form of spasm due to irritation of the intestinal walls. The irritation produces spasm and the spasm in turn keeps up the irritation. Mansell Moullin thus describes the process as met with in cases of duodenal ulcer :

“All that the pain really indicates is that there is an irritable hyper-responsive condition of the mucous membrane so that a stimulus which in ordinary circumstances would produce only a normal result, calls into play a reaction which is not only excessive in amount, but which persists and continues so long as the condition is present. If this goes on, if the spasm and contraction are kept up, it ends in the establishment of a typical Vicious Circle, the increased respons-

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<sup>1</sup>For further details cf. Obstruction and its Vicious Circles, by J.B.H., *Clinical J.*, 1915, I., p. 145.

iveness of the mucous membrane intensifying the muscular spasm, and the increased muscular spasm irritating the mucous membrane still more by crushing the tender surfaces together. It is the formation of this Vicious Circle that holds the secret not only of the symptoms that are present in what is commonly known as duodenal ulcer, but of the reason why they are relieved with such certainty and success by the operation of gastro-enterostomy when all else has failed.”<sup>1</sup>

The colon is another frequent seat of spasm, especially when coprostasis has caused irritation of the mucous membrane. Coprostasis may be both cause and effect of spasm :

Mathieu and Roux write :

“ Not only does the spasm cause and keep up the constipation, but the constipation in its turn keeps up the spasm and the colitis.”

And again :

“ Under the influence of spasm faecal matters are retained in the intestine, which is thus kept in a state of constant irritation. This irritation then provokes painful manifestations and various reflexes, some of short, some of long circuit. Those of short circuit are confined to the intestinal walls, while the longer ones take a further route and involve the abdominal plexuses. These spasmogenic reflexes in their turn perpetuate the constipation and the intestinal irritation. Thus is formed a Vicious Circle, which, when once established, shows no tendency to disappear spontaneously.”<sup>2</sup>

**Displacement.** The intestines are liable to various forms of displacement which may be a self-

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<sup>1</sup> *Lancet*, 1912, I., pp. 564, 566. Cf. also Schryver and Singer, *Quarterly J. of Med.*, VI., pp. 331, 337.

<sup>2</sup> Pathologie Gastro-Intestinale, Series I. (1909), pp. 149, 442, 448 ; Series III. (1911), pp. 93, 303. Cf. also Schmidt, *Klinik der Darmkrankheiten*, p. 328.

aggravating condition. A striking example occurs when the transverse colon descends into the pelvis forming an M-shaped loop. The longer the loop the greater the tendency to the accumulation of fæces, while the accumulated fæces favour further elongation and descent. In connection with such visceroptosis adhesions are apt to form at the various intestinal flexures, causing permanent kinking of the gut and aggravation of the stasis, as Arbuthnot Lane has so frequently pointed out.

Hernia presents another common example of displacement. Every time the gut descends the ring tends to enlarge, which enlargement facilitates a redescent of the gut. Further, a strangulated hernia frequently provokes vomiting and vomiting increases the strangulation (**Plate V. d**).

**Inflammation.** Enteritis may also be self-perpetuating. The inflammatory condition leads to impaired peristalsis and this is followed by stasis, increased bacterial growth and further inflammation.

E. von Ofenheim writes :

“The question as to the effect of stasis on bacteria and of bacteria on stasis is interesting, for a Vicious Circle has repeatedly been proved to exist between them. Stasis causes bacterial poisons to be formed; these poisons again have a paralysing effect on the intestines, and in this way add to the stasis.”<sup>1</sup>

The appendix is probably the commonest seat of enteritis. Here the inflammatory process is apt to cause some obstruction of the duct with a secondary retention of secretions. Such retention in its turn aggravates congestion and obstruction of the duct. Progressive accumulation and congestion then result, until a completely closed cystic cavity

<sup>1</sup>*Proc. Royal S. of Med.* (1913), VI. (i.), (*Alimentary Toxæmia*), p. 326.

is formed.<sup>1</sup> The retained matters also excite inflammation of the muscular walls and diminish peristalsis, thus promoting further retention (**Plate V. e**).

Similar correlations may be associated with chronic appendicitis leading to fibrosis.

Battle and Corner write :

"Fibrosis of the appendix interferes with the completeness of its peristaltic action, and as a result the tube will become incapable of emptying itself. By these means a Vicious Circle is established in that more pabulum remains within for the bacteria to flourish upon, and the more bacteria flourish, the more likely it is that chronic inflammation will progress, and the organ become still more incapable of performing its own evacuation. Such a condition may be called appendicular constipation. The inspissation of the contents will lead to the formation of an appendicular calculus or faecal concretion, which may be likened to scybala elsewhere in the large intestine."<sup>2</sup>

The cæcum is another region of the intestine which is very liable to inflammation, giving rise to typhlitis. At times the mischief may be due to the escape into the cæcum of toxic matters from the appendix :

Battle and Corner write :

"The Vicious Circle results from the fact that the inflammatory condition will impair the contractile power of the cæcum, and so lead to further bacterial growth and further chronic inflammation. In this way a colitis may be established throughout the whole length of the large bowel."

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<sup>1</sup>The process here described applies to many of the ducts of the body, e.g. the pancreatic duct, the bile duct, the salivary duct and intestinal diverticula.

<sup>2</sup>Surgery of the Diseases of the Vermiform Appendix, pp. 30, 38. Cf. also Stewart, *Practitioner*, 1910, I., p. 790.



And again :

“Owing to the pause of the products of digestion in the cæcum, . . . the fermentative processes initiated in the appendix will proceed to further stages in the cæcum. As a result a secondary subacute or chronic typhlitis is started which leads to interference with the muscular action of the cæcum and further retention of the contained fermenting fæcal mass. In this way a Vicious Circle has been started, and the processes and their results may extend along the colon from segment to segment.”<sup>1</sup>

Residents in the tropics are liable to a special form of chronic inflammation of the alimentary tract known as sprue or psilosis which is complicated by what Manson calls a “Vicious pathological Circle.” The dominant factors are dyspepsia leading to malassimilation, with tissue starvation and destruction. As a result of this lesion of the mucosa digestion and absorption are interfered with and result in further malnutrition which frequently terminates fatally.<sup>2</sup>

**Obstruction.** Mechanical obstruction has already been alluded to in connection with several disorders. But the same complication occurs in a variety of circumstances, as for example through simple inspissation of the fæces caused by unusual absorption of the liquid constituent. Moreover hardened fæces may give rise to fæcal concretions which enlarge by further deposits, much as do biliary or vesical calculi.

Mummery writes :

“The longer fæcal material is delayed in its passage along the colon, the harder will it become, owing to the absorption of water by the bowel walls ; and the

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<sup>1</sup>Surgery of the Diseases of the Vermiform Appendix, pp. 30, 70.

<sup>2</sup>Allbutt and Rolleston, System of Medicine, II. (ii.), pp. 550, 557.

harder it becomes the less easily will it be driven on by peristalsis, so that a Vicious Circle is soon established."<sup>1</sup>

In many conditions of stasis some degree of hypothyroidism may be brought about through the absorption of bacterial toxins. Such hypothyroidism in its turn weakens nervous and muscular activity which is followed by further stasis.

McCarrison writes :

"The stasis once established may lead to subthyroidism by the action on the gland of the toxic products of bacterial growth in the static bowel, or the abnormal processes of digestion may interfere with the efficient elaboration of the thyroid's secretion, thus reducing its physiological activity. A Vicious Circle is thereby established which in either event augments the thyroid defect as well as the stasis."<sup>2</sup>

Again faecal stasis is often associated with a great accumulation of gas which impairs the contractile powers of the muscular walls, and this impairment leads to further accumulation. The distention also perpetuates itself by diminishing the absorption of gases by the blood-vessels.

Nothnagel writes :

"As soon as the amount of gas present exceeds a certain limit, the intestine becomes distended, and this inhibits the absorption of gas by the blood-vessels of the intestinal wall. In addition the excessive distention impairs the contractile powers of the intestinal musculature. All three factors in their turn lead to the further accumulation of gas in the intestine. In this way a Vicious Circle which cannot be interrupted results, and causes the colossal meteorism occasionally seen in stenosis of the intestine."<sup>3</sup>

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<sup>1</sup> Diseases of the Colon, p. 219.

<sup>2</sup> The Thyroid Gland, pp. 138, 187. Cf. also *Practitioner*, 1915, I., p. 66.

<sup>3</sup> Diseases of the Intestines and Peritoneum, pp. 140, 638. Cf. also Mummery, Diseases of the Colon, p. 35.

Another form of obstruction is due to intussusception, when the intestine is telescoped on itself and the intussusceptum excites active peristalsis in the intussusciens. The peristalsis in turn increases the length of the invaginated intussusceptum, cause and effect acting and reacting reciprocally on each other.

**Ascites.** Attention has already been directed to the self-perpetuating character of effusion into the pericardial and pleural sacs. Peritoneal effusions may be similarly complicated. When they are caused by heart failure they may in their turn aggravate such failure and thus cause grave peril to life. Again ascitic effusion, by pressure on the renal veins, may impede the excretion of urine; the impeded excretion further increases the ascites.

## VI. THE RECTUM AND ANUS.

**Constipation.** The most important process of reciprocation falling under this heading is that associated with habitual constipation, which is one of the commonest ills of civilized life. The disorder may be congenital or acquired, local or constitutional, physical or psychical, trivial or fatal. No age, no sex, no occupation, no race, no country is immune. In brief, the disorder is of well-nigh universal interest, particularly to the physician, the sociologist, the psychologist, the teacher.<sup>1</sup>

Some forms of constipation have already been alluded to in the previous section; others are associated with the rectum and the anus. In the first place must be mentioned the habitual disregard of the natural call, such disregard being followed by a progressive blunting of the associated reflex and by increased constipation.

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<sup>1</sup>For further details cf. Vicious Circles of Habitual Constipation, by J.B.H., *Practitioner*, 1915, II., p. 560.

Again fæces, when unduly retained in the rectum, lose much of their contained liquid by absorption, and form dry and hard scybala. Their expulsion is difficult and the difficulty favours retention.

Fæcal stasis in the rectum, when persistently neglected, is apt to produce atony and dilatation of the rectum, conditions which aggravate the primary stasis. The dilatation thus induced may affect the whole circumference of the bowel ; in other cases the rectum becomes the seat of local pouching, more especially in old age. The pouching both results from and causes constipation.

Nascher describes the process :

“ The weakening and waste of muscle fibres, whereby peristaltic activity is diminished, is frequently accompanied by neglect of the aged to attend the call of evacuation of the bowel, and this last is the main cause of the dilatation of the colon and rectum, whereby pouches are formed. Here we see one of the many Vicious Circles which are found in old age. The diminished elasticity of muscle permits dilatation of the gut, which consequently becomes filled with fecal matter distending the bowel, this distension further stretching the fibres and impairing their elasticity.”<sup>1</sup>

A similar condition may lead to the formation of a rectocele, such as is common in women. As the fæces collect in the sac caused by the bulging rectal wall, great straining at stool is required to expel the fæces. This straining increases the size of the pouch, leading to further lodgment and increased straining.

Dyschezia is another cause of habitual constipation since it inhibits peristalsis and postpones expulsive efforts. Such constipation may again increase the lesion which caused the pain.

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<sup>1</sup>Geriatrics, p. 34.

Robin and Dalché refer to some forms of dyschezia, which are met with in women :

“ A uterine displacement, a peri-uterine phlegmasia, a hæmatocele, a salpingitis, a fibroid, etc., may act mechanically and give rise to constipation, which is followed by quite a number of dyspeptic symptoms. . . . On the other hand, constipation may itself do harm to a healthy uterus, and by means of a Vicious Circle may aggravate the uterine disorders to which it was primarily due.”<sup>1</sup>

In neurasthenic persons the ovary, even when healthy, may become tender and cause pain when scybala pass over it. Such pain may then tempt a woman to postpone defæcation, with the result that her scybala get harder and cause more pain (Plate V. f).

Spasm of the sphincter due to hæmorrhoids or fissure is another cause of constipation which in its turn perpetuates those disorders.

Ball writes :

“ As a result of the constant motion and distention and by the lodgment of particles of fæces in the rent, continued irritation is set up, which in turn occasions spasm of the sphincter. The spasm once started, the irritation is increased, and so a Vicious Circle is established, and the result is that the ulcer is never allowed to heal.”<sup>2</sup>

**Prolapsus Ani.** There is frequently a mutuality of cause and effect in the case of prolapsus recti. Prolapse causes tenesmus and tenesmus increases prolapse. Prolapse also causes relaxation of the sphincter ; such relaxation favours prolapse.

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<sup>1</sup>Traitement Médical des Maladies des Femmes, p. 18.  
Cf. also Schmidt, Klinik der Darmkrankheiten, p. 443.

<sup>2</sup>The Rectum and Anus, p. 131. Cf. also Treves, System of Surgery, II., p. 754.



Edwards writes :

"The more the bowel comes down, the more is the sphincter stretched and relaxed, and the increasing atony favours the repetition of the prolapse."<sup>1</sup>

**Strangulation of Piles.** Prolapsed piles sometimes become strangulated and cause such irritation as to provoke spasm of the sphincter. The spasm increases the strangulation.

Spriggs writes :

"It is important to remember that whilst chronic constipation may cause piles, tender piles will, by making constipation painful, cause constipation."<sup>2</sup>

**Oxyurides.** A circular reaction may occur in persons whose rectum is infested with oxyurides. The itching and scratching at the anus lead to the helminths or their ova being caught under the nails, conveyed to the mouth or food, and swallowed by the host. From the stomach the ova reach the intestines and rapidly attain maturity. Thus the irritation ensures by auto-infection successive generations of the parasite. Fertile ova are frequently discoverable under the finger-nails of the oxyuris host, and Cabot believes that fresh infection is an almost daily or nightly occurrence.<sup>3</sup> Possibly there may also be infection by an ascending current during the act of vomiting.<sup>4</sup>

**Pruritus Ani.** This forms a very troublesome neurosis especially in predisposed persons. The pruritus leads to scratching and the scratching intensifies the itching.

As Treves says :

"The itching is so intense that it is impossible to

<sup>1</sup> Diseases of the Rectum, Anus and Sigmoid Colon, p. 367.

<sup>2</sup> *Practitioner*, 1910, I., p. 628.

<sup>3</sup> Modern Clinical Medicine, p. 551.

<sup>4</sup> Debove, Achard and Castaigne, *Maladies du Tube Digestif*, II., pp. 306, 327.

avoid scratching, which, instead of giving relief, only adds to the trouble."<sup>1</sup>

This process of self-aggravation, however, is only temporary. A sense of satisfaction is also yielded by scratching and may culminate in a form of orgasm which ends in a state of depression and relief.

The above regional description of injurious circular reactions may be concluded by a brief survey of the nervous, muscular or chemical mechanisms connecting the various portions of the digestive tract with one another and with other great systems of the body.

The functional activities of the mouth, stomach, intestines, liver and pancreas are all linked together by reciprocally acting correlations, so that if one organ suffers all the others are more or less sympathetically affected. If unsuitable or badly-cooked food enters the stomach it may set up fermentation with the production of lactic and butyric acids, which irritate the gastric mucosa, provoke catarrh and cause an unhealthy secretion of mucus, which further hinders digestion. Moreover the excessive evolution of gases weakens peristalsis and this in turn induces stasis and more fermentation. Doubtless the formation of the gastric hormone is also checked.

As a result of these disorders the intestines, liver and pancreas are subjected to abnormal reflex stimuli which disturb their physiological activities. The ingesta, as they reach the duodenum, are unprepared for intestinal digestion and absorption, and irritate the mucosa. The alkaline juices are unable to neutralise the normal acid secretions of the stomach when these are combined with lactic and butyric acid, so that the reaction of the food in the intestines

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<sup>1</sup>System of Surgery, II., p. 793. Cf. also Hirschman, Diseases of the Rectum, p. 105.

continues acid instead of alkaline, and this results in irritation and disturbance of the processes of secretion. Bile is retained in the liver, instead of being poured into the intestine, and suffers in composition owing to the reflex irritation of the liver caused by the disorders in the stomach and intestines. The liver loses the power of arresting and destroying many of the toxins that reach it during the processes of digestion. These toxins therefore continue in the circulation and disturb the normal control of the nervous system over digestion.

Further, owing to the loss of the antiseptic powers of bile, the pancreatic juice mixed with food rapidly undergoes decomposition, with the production of poisons such as skatol, indol and a variety of poisonous alkaloids. These in their turn are absorbed and react injuriously on the processes of digestion. Doubtless also the production of secretin is diminished with injurious reverberation. Thus cause and effect react ceaselessly on each other and explain the chronicity of many digestive troubles.

But not only are there reciprocal correlations between the various digestive organs. There is also the closest synergy and sympathy between the digestive and all other systems, percussion and repercussion extending to the most intimate processes. Thus it is a matter of every day experience that the psychical state and digestive functions are inter-dependent. Disturbance of either may grievously upset the other. As Hippocrates long ago laid down in his famous aphorism :

ὥσπερ τοῖσι δένδρεσιν ἡ γῆ, οὕτω τοῖσι ζώοιςιν ἡ γαστήρ, "What the soil is to the tree that the stomach is to the animal."<sup>1</sup>

<sup>1</sup> Περὶ χυμῶν, § 11. Cf. also The Story of the Belly and the Members, as told by Shakespeare, Coriolanus, I. (i.), 101.

It is on this relation of the digestion to the animal that many disorders depend. If digestion is out of order, the animal suffers. If the animal is out of health its digestion suffers ; here is involved the problem of nutrition in all its ramifications.

The sensitive tissues of the nervous system might on *a priori* grounds be expected to suffer early where the sources of nutrition are curtailed through defective digestion, and such is found to be the fact. Impaired digestion quickly disturbs the nerve centres, and ill nourished nerve centres soon react on the digestive processes, these organs reciprocally embarrassing each other. Worse still, if, in consequence of retention and decomposition of food, poisons are brewed and the blood which should nourish the nerve tissues is itself tainted. No wonder that under such conditions morbid interactions are set up which reverberate in many directions. Such interactions may be caused by disorder in any part of the digestive tract from the mouth to the anus. Everywhere may toxic conditions arise which injure the nervous tissues. Pyorrhœa, gastrectasis, coprostasis are but a few illustrations of daily occurrence.

Other reciprocal correlations exist between the digestive organs and the heart. For example, lowered vitality resulting from chronic gastritis may lead to an irregular and weak cardiac action, which further interferes with digestion. Even an accumulation of flatulence may be a source of cardiac distress which reacts on equanimity and consequently on digestion. This is especially common where the heart is already unsound.

Robin writes :

“ Gastric disorders are very apt to disturb the action of a healthy heart. All the more readily will they affect a diseased organ, even though the latter originally caused the dyspepsia.

This Vicious Circle, as a result of which the diseased

heart gives rise to gastric disorders which in turn react on the heart, is exceedingly common, and many errors of diagnosis will be avoided if this fact is borne in mind."<sup>1</sup>

The respiratory functions may also be depreciated by disorders of digestion, the effect being especially injurious in children.

Arbuthnot Lane writes :

"The diminution in respiratory capacity which is brought about by indigestion in young people, is a matter of vital importance, and is a very material factor in lowering the activity of all the vital processes in the body. In the first instance deficient aëration and oxygenation result from serious alterations in the abdominal mechanics. Later a Vicious Circle is formed, the deficient aëration impairing digestion processes."<sup>2</sup>

These few illustrations must suffice to indicate some of the inter-dependences existing between the digestive and other systems of the body. The list, however, is far from exhausted ; for disorders of digestion are so closely associated with other disorders of the body that disturbance of the equilibrium existing between them radiates far and wide, cause and effect reacting continuously on each other.

The study of these correlations throws fresh light on another aphorism of Hippocrates :

*Συμπαθεά πάντα· κατὰ μὲν οὐλομελίην πάντα, κάτα μέρος δὲ τὰ ἐν ἐκάστῳ μέρει μέρεα πρὸς τὸ ἔργον.* "The whole body sympathises with every member, and every member with the whole body throughout its structure."<sup>3</sup>

<sup>1</sup> Les Maladies de l'Estomac, p. 966.

<sup>2</sup> Operative Treatment of Chronic Constipation, p. 16.

<sup>3</sup> Περὶ τροφῆς, § 23. Cf. also I. Corinthians, XII., 26.



## Chapter Seven

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### THE URINARY SYSTEM



DISORDERS of the urinary apparatus present illustrations of organic, mechanical, neurotic and chemical forms of Vicious Circles, some of which possess considerable clinical importance.

We shall deal in order with :

- I. The Kidneys
- II. The Ureters
- III. The Bladder and Prostate
- IV. The Urethra

### THE KIDNEYS

The kidneys are the chief emunctories of the body and excrete large quantities of toxic and effete substances that result from physiological processes. The healthier the kidneys the greater their excretory efficiency ; the greater that efficiency the healthier the kidneys will remain. In disease an excess of toxic materials of abnormal virulence is formed and thrown on to the kidneys for excretion, and such an increase of waste products within limits tends to increase the eliminating activity of the kidneys ; by means of this mechanism many diseases are self-limiting.<sup>1</sup>

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<sup>1</sup> A large number of diseases are self-limiting until a Vicious Circle supervenes and interferes with *natura mediatrica*. Striking illustrations of such interference occur in nephritis, bronchitis, pleurisy, apoplexy, cardiac failure, tuberculosis etc.

It frequently happens, however, that such toxic and waste products tax the kidneys beyond their capacity, as a result of which they are retained in the blood where they further depreciate renal efficiency, and so the process is perpetuated.

**Nephritis.** Such a mutuality of cause and effect is met with in various forms of nephritis. Toxins in the blood may produce nephritis and such nephritis keeps the blood toxic (**Plate VI. a**). Retention toxæmia is added to the primary toxæmia. There may be slight renal impairment or total anuria according to the virulence of the poison. Cf. also p. 68.

Adami writes :

“Functional inadequacy of the kidneys is not without its effect upon the composition of the blood. The quantity of water eliminated may deviate considerably from the normal, and waste products may be retained instead of excreted. The quality of the blood is thus depreciated, and, being laden with toxic substances, it in turn exerts an irritating and deteriorating effect upon the kidneys. In this way a Vicious Circle is set up, as a result of which the condition of the patient goes rapidly from bad to worse.”<sup>1</sup>

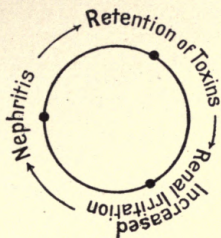
Destructive changes in the renal epithelium appear in some cases to cause a product of the internal secretion from the kidneys (renin) to be cast into the circulation and in its turn to further damage the renal tissues.

Chauffard and Laederich write :

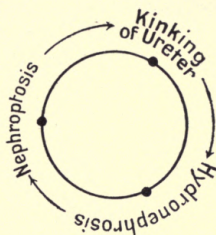
“There can be no doubt that certain alterations in the renal cells may give rise to toxic matters, which in their turn perpetuate these alterations and create a

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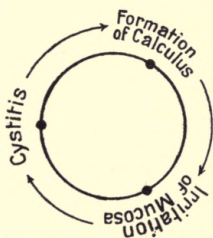
<sup>1</sup> Principles of Pathology, II., p. 735.



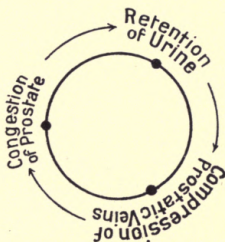
(a) NEPHRITIS



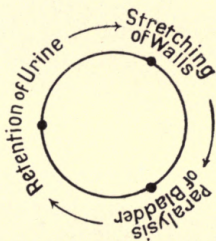
(b) NEPHROPTOSIS



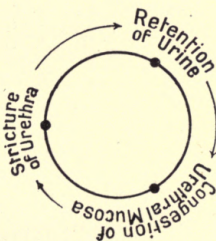
(c) CYSTITIS



(d) PROSTATIC RETENTION



(e) OVER-DISTENTION OF  
BLADDER



(f) URETHRAL STRICTURE

**Plate VI.—Circles associated with the Urinary System.**

true Vicious Circle, the effect of which is a more or less indefinite continuance of the nephritis.<sup>1</sup>

The swelling of the kidneys associated with many forms of nephritis is apt to interfere mechanically with the circulation and thus becomes a self-aggravating condition. Total anuria may result and call for incision of the cortex.

Fischer writes :

“ Vicious Circles are established in many organs when once they begin to swell. The swelling compresses their blood supply and thus aggravates their already precarious state. Dehydration of the kidney by the salt restriction scheme of therapy may suffice to save it.”<sup>2</sup>

After an attack of inflammation the kidneys are frequently prone to recurrence of the disease on slight provocation. Each fresh attack seems to injure fresh areas so that the disease, on each occasion, advances a step further. Increased susceptibility and recurrence act and react on each other, the kidneys becoming a *locus minoris resistentiæ*.

According to Hare a circular reaction is often present in renal cirrhosis as a result of the associated vaso-constriction. This vaso-constriction leads to increased diuresis, thirst, increased ingestion of water and further diuresis. The increased amount of urine is the result of the circulatory changes instituted by the organism to maintain the ordinary rate of excretion.

Hare writes :

“ There is on this view a distinctly appreciable and highly Vicious Circle in operation. The Circle comprises

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<sup>1</sup>Brouardel et Gilbert, *Maladies des Reins*, p. 166. Cf. also Kolmer, *Infection, Immunity and Specific Therapy*, p. 505.

<sup>2</sup>Edema and Nephritis, pp. 30, 613.

continuous vaso-constriction : deficiency of water in the tissues : thirst : increased ingestion of water ; and increased diuresis. The water drunk does not adequately relieve the thirst, since it fails, on account of the peripheral vaso-constriction, to flush adequately the tissues and thus to remove the essential cause of the thirst : in other words, the water drunk is largely short-circuited through the kidneys."<sup>1</sup>

Nephritis may also perpetuate itself when complicated by ascites, since the ascites interferes with the secretion of urine by pressure on the renal veins or on the ureters. Such interference in turn increases the ascites.

Romberg writes :

“ Ascites may obstruct the escape of blood through the renal veins, and by thus retarding the circulation through the kidneys may diminish diuresis. An important *circulus vitiosus* may be established in this way, unless the œdema and transudations can be got rid of.”<sup>2</sup>

Again some forms of ascites excite thirst, the gratification of which may increase the dropsy. In the words of Horace : “ *Crescit indulgens sibi dirus hydrops.* ”<sup>3</sup>

**Movable Kidney.** In neurasthenic persons, especially women, chronic ill-health may be associated with a movable kidney. The over-sensitive nervous system renders the sufferer unduly conscious of the abnormal mobility, while the persistent ache renders the nervous system more and more sensitive.

<sup>1</sup> Food Factor in Disease, II., p. 332.

<sup>2</sup> Krankheiten des Herzens und der Blutgefäße, p. 282.

<sup>3</sup> Odes, II., 2. On the form of ascites alluded to by Horace cf. Parkes Weber, *British Med. J.*, 1916, II., p. 200.



Indeed with a sensitive introspective individual the mere idea of possessing a floating kidney may become an obsession stirring up a host of subjective symptoms.

Such undue mobility of the kidney is frequently associated with visceroptosis, the symptoms of the two disorders merging into one another.

**Hydronephrosis.** Hydronephrosis is a serious lesion which may result from undue mobility of the kidneys, when nephroptosis leads to kinking of the ureter and renal vessels, followed by congestion and retention of urine and consequently by increased nephroptosis.

The origin of the ureter is normally at the most favourable part of the pelvis for the escape of urine. As the kidney descends, however, it revolves on a sort of pivot, leaving the uretero-pelvic junction at a higher level, so that the escape of urine is more and more impeded.<sup>1</sup> The condition indeed once started grows automatically worse ; the kinked ureter causes more and more obstruction to the escape of urine, while the increased weight of the kidney due to the venous congestion and retained urine aggravates the kink. The resulting hydronephrosis leads to a gradual disorganisation of the renal functions and to a destruction of the renal tissues (**Plate VI. b**). In course of time the whole gland may be destroyed, nothing but a thin-walled sac being left to mark the site of the original kidney.<sup>2</sup>

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<sup>1</sup> Kelly and Burnam give some illustrations showing the gradual change in the level of the uretero-pelvic junction. *Diseases of the Kidneys, Ureters and Bladder*, I., pp. 526, 531.

<sup>2</sup> In renal tuberculosis the gland may also be totally destroyed by the operation of a Vicious Circle,

In some cases the insertion of the ureter into the hilum may be abnormally high as to leave a pouch lying below the point of insertion and always full of urine. The pouch so formed may compress the ureter, causing further distension and further compression. Valvular folds and other abnormalities may lead to similar complications.

According to Shattock hydronephrosis and polyuria are sometimes associated with idiopathic dilatation of the bladder, the obstruction which has led to the hydronephrosis arising not from organic changes but from disordered innervation. After discussing alternative theories Shattock writes :

“The polyuria probably results from the hydronephrosis, and there being a persistent obstruction a Vicious Circle arises, in which the hydronephrosis brings about polyuria and the resulting polyuria brings about a further increase in the hydronephrosis.”<sup>1</sup>

Similar idiopathic dilatation is met with in the case of the œsophagus, the stomach and the colon, the probable cause being in each case some neuropathic influence.

**Nephrolithiasis.** Reciprocal conditions are established in connection with renal calculi, which originate with the deposition in the urinary passages of colloid or albuminous matters such as mucus, blood or pus. Within the meshes of this organic framework uric acid or other deposits are entangled and agglutinated into a nucleus, with consequent irritation of the lining membranes. This irritation then leads to further exudation of colloid matters, which in turn collect fresh deposits and provoke fresh irritation. In this way the process continues, while the stone gradually increases in size. On the

<sup>1</sup> *Proc. Roy. S. of Med.* (1909), II. (iii.), (*Pathology*), p. 97.

other hand secondary calculi result from infective processes, generally associated with stagnation of the urine and precipitation of phosphates, the resulting concretion forming the nucleus of a calculus. From this point the process perpetuates itself automatically as described above.

Much the same sequence occurs in cases of pyo-nephrosis complicated by a calculus.

Morris writes :

"The relation between renal calculi and pyo-nephrosis is a double one. On the one hand the calculus may be, and frequently is, the cause of the pyo-nephrosis, but, on the other hand, it may be secondary and arise from the phosphatic deposits of the alkaline urine in the renal cavity."<sup>1</sup>

## II. THE URETERS

Simple tubes such as the ureters are not so often associated with circular reactions as are complex organs. Moreover several of the ureteric disorders, e.g. those met with in nephroptosis and hydronephrosis, have been referred to in connection with disorders of the kidneys.

There are however one or two additional ones which must be mentioned.

**Calculus.** A renal calculus in its progress towards the bladder may be impacted in, and block, the ureter, setting up inflammation of the mucous lining. This inflammation may aggravate the obstruction, and by causing stagnation of urine lead to an increase in the size of the stone through phosphatic accretion.

If retained for a length of time the calculus may give rise to a diverticulum in which urine accumu-

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<sup>1</sup>Surgical Diseases of the Kidney and Ureter, I., p. 446.

lates. This also leads to growth of the calculus and to progressive enlargement of the diverticulum.

**Dilatation.** Matthews Duncan draws attention to a curious condition in which frequent micturition leads to narrowing of the vesical orifices of the ureters, followed by dilatation of the higher portions of the ureter. The narrowing in its turn perpetuates excessive secretion and frequent micturition, and so the process continues.

Duncan writes :

“ In cases of diabetes insipidus the ureters are often found dilated, as also the kidneys. This curious circumstance seems to be explained by some recent observations which almost prove that the disease known as wetting of the bed in children is the cause in some cases of dilatation of the ureter and of the kidney, and of danger and even death. This wetting of the bed or frequent urination in children is far from being a complaint to be considered as altogether of trifling importance. In these cases retention in the ureter may occur, and it is explained by supposing that contraction of the bladder leads to the frequent urination, and also to closure of the vesical orifices of the ureters, produces dilatation of them, dilatation of the kidneys and danger of death. This theory will also apply to diabetes insipidus ; and if it is so, you have another example of the Vicious Circle. There is a large quantity of urine, which leads to frequent urination : frequent urination leads to obstruction of the ureters at their vesical orifices, and partial obstruction of the ureters leads to excessive secretion ; the excessive secretion requires frequent emptying ; the frequent emptying produces obstruction of the ureters ; and the obstruction of the ureters leads to excessive secretion, and so on.”<sup>1</sup>

In other cases the opening of the ureter into the bladder may be abnormally small, impeding the

<sup>1</sup> Clinical Lectures on Diseases of Woman, p. 82.

flow of urine, and giving rise to a sacciform dilatation. This dilatation may in turn further diminish the opening and thus complete the round.

### III. THE BLADDER AND PROSTATE

**Cystitis.** Cystitis may be complicated by various self-perpetuating conditions. One of these is the congestion and irritability of the neck of the bladder associated with increased frequency of micturition.

Mansell Moullin writes :

“ The tissues become more and more swollen. The epithelium becomes abraded, or perhaps a small fissure is formed ; the neck of the bladder becomes the seat of an intense burning pain, which is made infinitely worse by the spasmodic contraction of the muscles around it, and a Vicious Circle is established. The irritation at the neck of the bladder causes increased frequency ; and the increased frequency makes the irritability worse, until at last the patient is reduced to a condition of the utmost misery.”<sup>1</sup>

Decomposition of the urine is another self-aggravating factor, owing to the carbonate of ammonia which is formed and which increases the cystitis.

Leroy d'Etiolles writes :

“ In cases of phosphatic gravel, the urine is ammoniacal, irritating and caustic to the mucous membrane of the bladder, the inflammation of which, by generating muco-pus, becomes in its turn a cause of alkalinity and of catarrh, forming thus a truly Vicious Circle in pathology, from which there is no exit without first altogether changing the composition of the urine.”<sup>2</sup>

<sup>1</sup> Enlargement of the Prostate, p. 125.

<sup>2</sup> *Traité de la Gravelle*, p. 510. Cf. also Pick and Hecht, *Clinical Symptomatology*, p. 599.



**Calculus.** Some interesting reciprocal relations are established during the growth of a vesical calculus, whether such calculus has descended from the kidney or has been primarily formed in the bladder. If a small nucleus slips into a healthy bladder, the irritation usually causes the calculus to be surrounded with an envelope of mucus in which successive layers of crystals are deposited. The growth of the stone then proceeds in an *acid* medium, the film of colloid being ever ready to attract fresh crystals of uric acid (or other substance) from the urine by molecular coalescence, while the enlarging stone keeps up the irritation and causes more and more mucus to be secreted.

Sooner or later, however, bacterial infection generally ensues, leading to cystitis. The film of mucus then becomes a *nidus* for the deposit of phosphatic accretions, and the growth of the calculus proceeds in an *alkaline* medium. The growing calculus increases the irritation, while the irritation leads to further deposits of phosphates, thus adding to the size of the concretion (Plate VI. c).

**Retention of Urine.** A striking example of a circular reaction is presented by retention of urine caused by prostatic hypertrophy. The venous plexuses surrounding the prostate are always of ample size and undergo further dilatation in elderly men. This explains how it is that when an enlarged prostate is congested, a considerable increase in the size of the gland results, sufficient in many cases to cause complete retention. The pressure of the accumulated urine in turn aggravates the venous engorgement, these two factors acting reciprocally on each other. J. L. Joyce has observed a marked diminution in the size of the prostate as soon as the bladder had been evacuated by catheterisation (Plate VI. d).

Desnos and Minet thus describe the sequence of events :

"The mechanism of the retention is clear. The rapid increase in size of the lateral lobes brings them into contact, the whole gland being compressed by the periprostic plexuses. Further the congested and œdematous mucosa forms a plug which obstructs the neck of the bladder. . . . Meanwhile urine is accumulating behind the plug and distending the bladder. The pressure of the liquid in this reservoir aggravates the venous congestion, until the obstruction at the neck of the bladder becomes insuperable."<sup>1</sup>

In some cases of prostatic hypertrophy the enlarged middle lobe projects into the bladder like a cone in such a way that the contained urethra may be closed by pressure of the urine on the outside of the cone. The enlarged lobe may also fall over and close the urethral orifice like a ball-valve, as soon as the bladder contracts. The greater the straining to evacuate the bladder, the more tightly is the orifice closed ; the tighter the closure the greater the straining.<sup>2</sup>

Chronic retention frequently causes the trigone to yield under the continual pressure, giving rise to a thin-walled post-prostatic pouch. When once formed, this pouch leads to further retention of urine, to increased straining and eventually to further bulging. Occasionally the pouch has assumed dimensions equal to those of the bladder itself.

<sup>1</sup> *Maladies des Voies Urinaires*, p. 411. Cf. also Guyon, *Leçons Cliniques sur les Maladies des Voies Urinaires*, II. p. 397 f. ; Fürbringer, *Die Krankheiten der Harn- und Geschlechtsorgane*, p. 313.

<sup>2</sup> An illustration of such hypertrophy is given by Wallace in *Practitioner*, 1905, II., p. 305. Other self-perpetuating conditions are described by Frisch, *Die Krankheiten der Prostata*, pp. 111, 140.

Atony of the bladder is another occasional complication, being due to over-stretching and consequent weakness of the vesical walls (**Plate VI. e**).

Lewis writes :

“ Prolonged or repeated retention, with overstretching of the organ, from any cause whatever, results in weakening of the detrusor muscles, reducing their contractibility and producing the condition called atony ; while, on the other hand, atony itself contributes to further retention by reason of the inability of the weakened muscles to expel the urine. Thus is established a Vicious Circle that forms the intimate relation between the two conditions.”<sup>1</sup>

Several artefacts may be created by the surgical interference that may be required in diseases of the bladder.

For example, catheterisation is often an indispensable operation, although there is a risk of its increasing the existing inflammation.

Thompson writes :

“ The cystitis, on the one hand, and the catheterism, on the other, exercise mutually inimical influences, and the patient becomes the victim of a Vicious Circle of actions, in which an absolutely indispensable remedy, the catheter, aggravates the inflammation of the bladder which therefore, in its turn, demands the instrument with increasing frequency.”<sup>2</sup>

Another complication frequently occurred in former days when lithotrity was prolonged over several sittings. Cystitis necessitated lithotrity, while the resulting fragments of crushed stone increased the cystitis.

<sup>1</sup> Keen, Surgery, IV., p. 299.

<sup>2</sup> Clinical Lectures on Diseases of the Urinary Organs, p. 147.

Guyon writes :

“ In former days when lithotrity was performed at short and numerous *séances* without chloroform, the fragments of crushed stone were left in the bladder. These more or less jagged fragments were often of considerable size and increased the irritation caused by the manipulations, which were done without any attempt at anæsthesia. Indeed the fragments caused far more irritation than did the original calculus. Attacks of cystitis followed, which were difficult either to avoid or to deal with, since they were directly due to curative treatment, and since their treatment always required a more or less considerable number of *séances*. There was no possible escape from this Vicious Circle.”<sup>1</sup>

**Neuroses.** Irritability of the bladder is not an uncommon complication of neurasthenia and in turn perpetuates that condition. Thus there are persons who, in view of an imaginary inconvenience they may be temporarily exposed to during a long railway journey, go on for days previously micturating every few minutes. They thus acquire a habit which may be permanent.

Moreover the greater the frequency of micturition the more abundant the secretion of urine. Here also there is a reciprocity of cause and effect. Other neuropaths suffer from retention ; the harder they strain in order to pass their water the less they are able to do so.

Such neurotic retention is doubtless due to an involuntary contraction of the compressor urethræ which totally prevents the flow of urine, and such retention in its turn increases the nervousness and incapacity. The condition is closely allied to stammering of the urinary organs which Sir James

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<sup>1</sup> La Vessie et la Prostate, p. 699.

Paget has described :

“Stammering urinary organs are not rare ; and they may be known by observing, sometimes in the same person, the exact parallelism between the difficulty of expelling urine and that of expelling the air in the ordinary speech-stammering. The patient can often pass his urine without any trouble, especially at customary times and places ; and, when he does so, the stream is full and strong, and he has ‘ nothing the matter with him.’ But, at other times, he suffers all the distress that he might have with a very bad urethral stricture. He cannot pass a drop of urine ; or, after a few drops, there comes a painful check ; and the more he strains, the less he passes ; and then complete retention may ensue, and over-filling of the bladder.”<sup>1</sup>

Another neurosis due to exaggerated reflex irritability is nocturnal enuresis. Some temporary derangement may start the habit, and this, if frequently repeated, may so act on the impressionable nervous system of a child as to persist after the removal of the exciting cause.

#### IV. THE URETHRA

**Congestion.** In acute gonorrhœa the mucous membrane may be so congested as to lead to retention of urine. Such retention in turn aggravates the congestion and so increases the obstruction. The more prolonged the retention the greater the swelling, and *vice versa*. The severe straining associated with tight strictures sets up a similar hyperæmic condition of the urethra which increases the stricture (Plate VI. f).

Urethral retention associated with uterine displacements is described in the next Chapter.

**Urethrocele.** Strictures of the urethra are not uncommonly complicated by retro-strictural dilata-

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<sup>1</sup> Clinical Lectures and Essays, p. 78.



tions. These dilatations contain decomposing urine and sometimes a calculus, and may be so situated as to press further on the strictured urethra and to provoke dysuria. Thus the dysuria is both cause and result of the dilatation.

Urethroceles may also arise from catarrh of the urethra through relaxation of the walls and the gradual separation of muscular fibres. Little by little the urine pushes aside the weakened tissues and forms a sac in which urine accumulates. Decomposition soon follows and tends to increase the urethritis.<sup>1</sup>



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<sup>1</sup>Thomas, Diseases of Women, p. 238.

# Chapter Eight

## THE SEXUAL SYSTEM



THE intimate relations that exist between different portions of the sexual system as well as between the sexual and the other systems of the body would on *a priori* grounds lead us to expect the presence of morbid circular reactions in cases of sexual disease. Such in fact is the case.

The two sexes will be dealt with separately.

### I. DISORDERS IN THE MALE

**Masturbation.** A common example is presented by neurasthenia associated with sexual malpractices. An exaggerated tendency to self-abuse is usually the result of a neurotic predisposition and in turn increases any existing nervous weakness.

Oppenheim writes :

"In many cases we have a Vicious Circle ; the tendency to masturbation is in itself a symptom of a neuropathic diathesis, and the masturbation again gives rise to a crowd of nervous disorders."<sup>1</sup>

Müller also describes the process :

"In neurasthenic persons of both sexes, especially if unmarried, there is a tendency to satisfy the sexual instinct by means of masturbation. Indeed it is often difficult to decide whether the masturbation should be regarded as a result or as a cause of the sexual neurasthenia, since a *circulus vitiosus* has generally been established."<sup>2</sup>

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<sup>1</sup>Lehrbuch der Nervenkrankheiten (1913), II., p. 1486. (Eng. Ed., 1911, II., pp. 1125-6).

<sup>2</sup>Neurasthenie, p. 181.

The serious results of sexual malpractices are frequently seen in our lunatic asylums. Mental deficiency is unquestionably both cause and effect of such malpractices.

Self-abuse may also result in physical disorders such as a chronic prostatitis and spermocystitis which maintain a state of erethism which favours an injurious degree of self-indulgence. In other cases there is a posterior urethritis and frequent spermatorrhœa, the two aggravating each other.

The latter disorders are said to be especially due to congressus interruptus.

Fürbringer writes :

"A condition of spermatorrhœa or of too facile pollution is almost invariably provoked ; moreover in addition to the sexual neurasthenia a chronic state of irritability of the posterior urethra is brought on, which gives rise to a *circulus vitiosus*." <sup>1</sup>

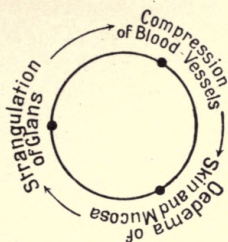
Sturgis lays emphasis on the same disorder :

"There is a constant hankering for more intercourse. This inordinate desire gives rise to more frequent copulation, until hyperæsthesia is set up in the prostatic urethra, which is sought to be relieved by more coitus, and thus a Vicious Circle is established. The more the patient copulates the more the irritation, and the greater the irritation the more the desire for coition." <sup>2</sup>

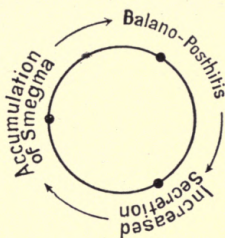
**Spermatorrhœa.** Injurious circular reactions also occur apart from self-abuse. Thus there may be an irritable condition of the nervous system which relieves itself too frequently by seminal discharges. Such excessive discharges frequently perpetuate the irritability.

<sup>1</sup> Störungen der Geschlechtsfunctionen des Mannes, p. 41.

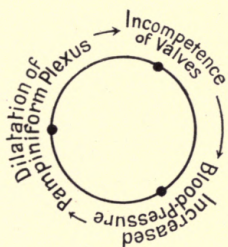
<sup>2</sup> Prostatorrhœa Simplex and Urethrorrhœa ex Libidine. *J. of Cut. and Genito-Urinary Diseases*, New York (1898), XVI., p. 270.



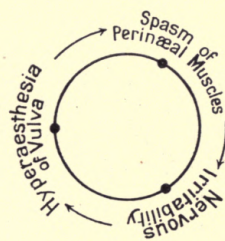
(a) PARAPHIMOSIS



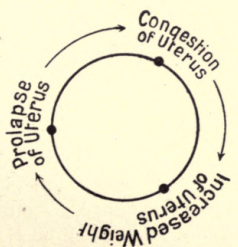
(b) BALANO-POSTHITIS



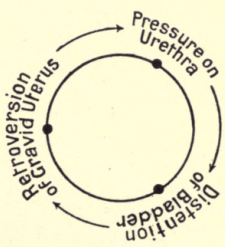
(c) VARICOCELE



(d) VAGINISMUS



(e) PROLAPSE OF UTERUS



(f) RETROVERSION OF GRAVID UTERUS

**Plate VII.—Circles associated with the Sexual System.**

Beard writes :

“Occasional seminal discharges in the healthy and unmarried are physiological—that is, they are not symptoms of disease. Such involuntary discharges, when excessively frequent, may be both results and causes of disease, indicating an abnormal, usually an exhausted, state of the nervous system, and in turn reacting on the nervous system, increasing the very exhaustion that caused it.”<sup>1</sup>

There is also an element of hypochondriasis which complicates these disorders, and makes them difficult to cure.

Paget thus describes them :

“The patients are full of apprehension, unable to divert their minds from their sexual functions, constantly watchful of their sensations and making them constantly more intense. And further mischief follows from all this : for the direction of the mind to the sexual organs makes both them and the parts of the sexual system associated with them more and more irritable ; it increases the secretion of the seminal fluid and hurries its discharge. The mind thus multiplies the source of its own misery.”<sup>2</sup>

Spermatorrhœa is often associated with insomnia, the two disorders reacting on each other.

Holmes writes :

“The emissions are most usually associated with, and probably result from, erotic dreams and images, which often disturb sleep ; and as the patient’s mind may be at the same time worried by the emissions which he fears and of which he is ashamed, a definite insomnia may result. And as insomnia naturally

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<sup>1</sup>Nervous Exhaustion, p. 70. Cf. also E. Jendrassik, Volkmann’s Sammlung Klin. Vorträge (Innere Medizin, 1906, No. 128-9.

<sup>2</sup>Clinical Lectures and Essays, p. 279.



depresses his energies and lowers his resistance, a Vicious Circle is established, which can easily produce the intensest form of neurasthenia."<sup>1</sup>

Excessive irritability of the erection and ejaculation centres may be brought about by any local irritation along the genital tract, reciprocal relations being usually present. A common illustration of this is seen in gonorrhœa which renders the sexual centres unduly sensitive, while these latter in turn increase the hyperæsthesia of the urethra, especially of its prostatic and bulbous sections.

Krafft-Ebing writes :

"It must always be borne in mind that any peripheral irritation in the sexual tract of the male, whatever the cause, . . . reacts on the ejaculation centre and induces a chronic state of increased irritability. This condition of irritability also spreads to the erection centre which is, both anatomically and functionally, so closely connected with the ejaculation centre. A *circulus vitiosus* is thus established, since the abnormal stimulation of the erection centre gives rise in its turn to a peripheral hyperæmia and irritation, sometimes even to ejaculation, which again reacts injuriously on the centres."<sup>2</sup>

**Impotence.** In the healthy individual there is a reflex physiological Circle formed by the reciprocal influence on each other of the central nervous system and the peripheral sexual organs, and on the harmonious operation of these correlations depends the *potentia coeundi*. Any psychical or physical disturbance of such correlations, on the other hand, may result in impotence ; for example, the fear of impotence may suffice to cause such disability.

<sup>1</sup> *Practitioner*, 1911, I., pp. 51, 53.

<sup>2</sup> Nothnagel, *Specielle Pathologie und Therapie*. Nervosität und Neurasthenische Zustände, by Krafft-Ebing, p. 191.

Such fear is sometimes purely psychical and has no solid foundation ; in other cases a trivial disorder may arouse such a powerful obsession that the *potentia coeundi* vanishes. Over-anxiety defeats its end own, while on the other hand success breeds success.

Morris writes :

"Some slight physical imperfection or want of general tone may give rise to a feeling of fear of impotence or of mistrust of self, or an exaggerated idea of the effects of past masturbation, or the memory of an unsatisfactory coitus may take possession of the mind, and an imaginary or false impotence will be the result. The mere thought that a sexual intercourse will be impossible or unsatisfactory is quite sufficient cause to make it so."<sup>1</sup>

**Paraphimosis.** Paraphimosis may be a self-aggravating disorder when the constricting ring of preputial skin and mucous membrane leads to venous engorgement of the glans, and this engorgement causes the ring to grow tighter and tighter. The strangulation leads to congestion and this in turn aggravates the strangulation (**Plate VII. a**).

**Balano-Posthitis.** Another circular reaction may be observed when the smegma under the prepuce is allowed to collect and decompose. Especially is this likely to happen where the orifice is narrow so that the prepuce cannot be readily withdrawn. An inflamed hyperæmic condition of the mucous surface of the prepuce is then kept up which narrows the orifice more and more. The phimosis causes retention of the smegma ; the retention sets up balano-posthitis and increases the phimosis (**Plate VII. b**). Preputial calculi occasionally form and add to the irritation.

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<sup>1</sup>Injuries and Diseases of the Genital and Urinary Organs, p. 43. Cf. also Ziemssen, *Cyclopædia of the Practice of Medicine*, VIII., p. 891.

Corner writes :

“The secretion decomposes and irritates both the glans penis and the prepuce, producing a chronic superficial balanoposthitis and a deeper chronic inflammation in the prepuce, causing its fibrosis and subsequent contraction on the glans penis. The meatus in it also becomes contracted so that it can no longer be withdrawn over the glans, and the secretions under it collect and ferment, producing further irritation. The greater the irritation of the glands by decomposing secretion, the greater the amount of secretion they produce. In this way a Vicious Circle is established.”<sup>1</sup>

**Varicocele.** In varicocele the tortuous and dependent veins of the pampiniform plexus are enlarged, while the valves become incompetent and the walls of the veins thinned. The larger the veins the greater the tension on their walls ; the greater the tension the more do the walls yield. When the valves become incompetent a further aggravating factor is added (Plate VII. c).

**Hydrocele.** Hydrocele is usually attributed to a disturbance of the mechanism governing the secretion of fluid into, and the absorption of fluid out of, the tunica vaginalis. When the quantity of fluid secreted is increased, such increase may compress the effluent lymphatics and so lead to a further accumulation.

In other cases the blood-pressure in the spermatic artery may, owing to arterio-sclerosis, be unequal to the task of driving the blood through the veins. Hence may result a venous congestion of the testicle and from time to time a hydrocele, leading in turn to further congestion.

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<sup>1</sup> Male Diseases in General Practice, p. 398.

## II. DISORDERS IN THE FEMALE.

The sexual system plays an even greater rôle in the life of a woman than it does in that of a man. Indeed in the former the functional correlations between the genital organs and the central nervous system often colour her entire outlook on life. We should expect, therefore, that disease would awaken many reverberations echoing and re-echoing between such sensitive organs, and the facts correspond with the anticipation.

**Neurasthenia.** Neurasthenia and local disease of the sexual organs very frequently perpetuate one another.

Amand Routh writes :

"We have frequently to deal with a Vicious Circle, with local and constitutional states so interacting, that no real improvement is possible until both the general and local states receive their due share of attention."<sup>1</sup>

Such a reciprocation may occur even in healthy females, leading a natural out-door existence with well-filled leisure and no undue tendency to introspection. But the disorder is far more prevalent in neuropaths with little to do and little else to think about than their own whims. General and sexual ill-health then form the commonest combinations, each disorder feeding the other.

Faure and Siredey write :

"Women suffering from disease of the sexual organs frequently shew signs of physical and moral depression which is closely allied to neurasthenia. Worn out by their sufferings, often anæmic through loss of blood or through prolonged confinement to the house, either in bed or on the sofa, these unfortunate women grow thin and feeble, and give way more and more to dis-

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<sup>1</sup> Allbutt, Playfair and Eden, Gynæcology, p. 737. Cf. also Thomas, Diseases of Women, p. 56.

couragement. They are now entrapped in a Vicious Circle, from which escape is difficult. Their neurasthenia induces dyspeptic disorders, and their malnutrition tends to aggravate their neurasthenia."<sup>1</sup>

This form of illness is especially apt to occur where there has been some physical or mental drain on the nervous system. For example, the excitement associated with parturition or such a local disorder as metritis, leucorrhœa, dysmenorrhœa or dyspareunia may start the morbid chain of events in which both the central and peripheral factors play a part.

MacNaughton Jones writes :

"All recent authorities agree that the nervous system can, through vasomotor effects and central nervous influences, induce ill-health and perversion of functions in the genitalia, causing, for example, amenorrhœa, dysmenorrhœa and menorrhagia. The converse is equally true, that morbid states of the genitalia which lead to excess, diminution or absence of functional activity, will affect the ganglionic and central nervous system. This 'action and reaction' it is that, once the Vicious Circle is formed, maintains the ill-health of both."<sup>2</sup>

One of the commonest local disorders is hyperæsthesia of the ovaries. Owing to the lowering of the neuron threshold the woman is worried and kept awake at night by an ache which would not affect consciousness, were she less sensitive. Her worry and insomnia then perpetuate her hyperæsthesia and often render life a burden both to herself and others. The menstrual period usually aggravates the disturbance.

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<sup>1</sup>Traité de Gynécologie Médico-Chirurgicale, p. 396.

<sup>2</sup>*Practitioner*, 1911, I., p. 68. Cf. also Herman and Maxwell, Diseases of Women, p. 73; Robin and Dalché, Traitement Médical des Maladies des Femmes, p. 27.



Herman and Maxwell write :

"In chronic pelvic pain with neurasthenia effects follow one another in a Vicious Circle. The patient feels more severely the pelvic pain because her nervous system is too sensitive. The persistent pelvic pain keeps her nervous system weak and sensitive and further weakens it."<sup>1</sup>

**Chlorosis.** Chlorosis, although usually a cause of scanty menstruation, at times leads to menorrhagia and metrorrhagia, which in turn aggravate the chlorosis.

Matthews Duncan writes :

"When a woman is chlorotic she fortunately has generally amenorrhœa, but if not, she will be very likely to have menorrhagia. And you have here an illustration of a Vicious pathological Circle. The menorrhagia increases the chlorosis, and, *vice versa*, the chlorosis aggravates the menorrhagia."<sup>2</sup>

Croom writes in the same strain :

"These cases are amongst the most difficult to treat, because they interact in such a way as to produce a Vicious pathological Circle—the drain on the system by the hæmorrhage tending to aggravate the very systemic condition which, in its turn, leads to the menorrhagia."<sup>3</sup>

It is difficult to account for the menorrhagia when the body can so ill spare the loss of blood. Possibly the explanation lies in the increased volume or low specific gravity or coagulability of the blood, or in a faulty nerve control.

**Pruritus Vulvæ.** Pruritus vulvæ is at times complicated by a circular reaction. The irritation may be purely nervous, but it is more often due to

<sup>1</sup> Diseases of Women, p. 79. Cf. also *British Med. J.*, 1910, I., p. 183.

<sup>2</sup> Lectures on the Diseases of Women, p. 124.

<sup>3</sup> Allbutt, Playfair and Eden, Gynæcology, p. 85.

some local disease. In either case the severe itching leads to scratching, and the scratching abrades the skin and accentuates the itching.

Gibbons writes :

“Scratching produces temporary relief, and with it those changes in the tissues which themselves lead to scratching, so that a Vicious Circle is established. The scratching eases the itching for a time, but the very relief which is brought about is at the cost of minute changes in the tissues which cause further scratching.”<sup>1</sup>

Vulvitis associated with vaginal discharges may be complicated in much the same way ; the irritation and rubbing reciprocally provoke each other ; the disorder is specially common in young girls.

Brocq writes :

“The child experiences a more or less acute sense of burning and itching which compels it to scratch itself. The scratching merely serves to augment the inflammation.”<sup>2</sup>

Allied to vulvitis is a condition resembling balanoposthitis in the male. If the smegma secreted by the vulvar or clitoridean glands is allowed to accumulate, decomposition, inflammation and excoriation of the mucous surfaces may result, leading to increased secretion and accumulation.

**Vaginismus.** Vaginismus is another disorder due largely to an abnormal nervous excitability of the woman, combined with irritability of the external sexual organs. The general and local conditions aid and abet each other (**Plate VII. d**).

Robin and Dalché write :

“It matters little whether the general state of health is the cause or the effect of the local condition, for the two react on, and aggravate, each other in a Vicious

<sup>1</sup> *British Med. J.*, 1912, I., p. 471.

<sup>2</sup> *Dermatologie Pratique*, I., p. 348.

Circle. Treatment must be directed to the nervous system, to the dyspepsia, to any visceral ptosis, to the anæmia, in fact to the entire organism which is out of order. Only when this is done will the local treatment of the vulvar irritation prove efficacious and permanent."<sup>1</sup>

Vaginismus is closely associated with dyspareunia which is often due to a slight laceration of the hymen. The difficulty of coitus causes more force to be used and as a result the hymen suffers further injury.

Berkeley and Bonney write :

"In patients such as these a dual condition exists, one physical and the other psychical. The orifice is undoubtedly tender—the pain that results in attempts at intercourse abolishes the sex-sense and inhibits the flow of mucus which normally under the influence of sexual excitement should assist the act. In consequence, resistance efforts are made, both voluntarily and involuntarily, the chief of which consists in a spasmodic contraction of the levatores ani muscles (vaginismus) whereby the orifice is narrowed and the act rendered yet more difficult and painful. Thus a Vicious Circle is established, its inception depending upon the sensitive condition of the hymen."<sup>2</sup>

**Displacement of the Uterus.** A variety of self-perpetuating conditions occur in connection with displacement and congestion of the uterus, a disorder which may be caused in a variety of ways. The primary prolapse leads to congestion and this favours increased prolapse (Plate VII. e). Especially is such a sequence common if a woman returns to hard work soon after childbirth before the completion of involution. Not only is the uterus bulky and heavy, but the ligaments are weak and relaxed.

The further the uterus descends in the pelvis the greater will be the interference with the circulation

<sup>1</sup>Traitement Médical des Maladies des Femmes, p. 284.

<sup>2</sup>Gynæcology, p. 106.

through its walls. Hence will result a persistent engorgement of its tissues ending in their hypertrophy. Such hypertrophy keeps up the displacement.

Complete procidentia is especially injurious, since the veins of the broad ligaments are then so compressed that the return of blood is impeded, resulting in œdema and still greater weight.<sup>1</sup>

Goodell draws attention to reciprocal relations that may be established between the uterus, vagina and bladder, especially in connection with hypertrophic elongation of the supra-vaginal portion of the cervix :

“It is a Vicious Circle throughout ; the prolapsing organ—say the vagina—tugs at the bladder, which yields, and in turn lends its weight towards the further descent of the former by alternately coercing and being coerced ; their united action at last begets the circular hypertrophy of the cervix ; the latter returns the favour by edging and nudging on the vagina, which responds by still more increasing the prolapse of the bladder and the hypertrophy of the cervix, and by aiding them in drawing out the supra-glandular portion of the cervix. Thus the reciprocation is kept up until the constantly elongating and growing cervix has attained length and weight enough to act aggressively.”<sup>2</sup>

In some cases such a hypertrophied cervix causes great vaginal irritation, acting much as if it were a foreign body and exciting expulsive efforts. Such efforts in their turn increase the descent and hypertrophy.<sup>3</sup>

Again an elongated and protruding cervix may be so strangulated by the vulvar ring that the return of blood is obstructed ; the strangulation leads to

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<sup>1</sup> Allbutt, Playfair and Eden, *Gynæcology*, p. 197. Cf. also Thomas, *Diseases of Women*, p. 383.

<sup>2</sup> *Lessons in Gynæcology*, p. 227.

<sup>3</sup> Barnes, *Diseases of Women*, p. 623.

oedema of the cervix and this aggravates the strangulation. The resulting swelling may be so great that considerable force may be required for replacement.<sup>1</sup> The condition somewhat resembles that of penis captivus described by Hühner.<sup>2</sup>

**Salpingitis.** When mucus or pus collect in the Fallopian tube, congestion and obstruction of the ostium uterinum are liable to follow, giving rise to hydrosalpinx or pyosalpinx. As the retained secretions undergo decomposition, further irritation is set up which aggravates the obstruction. In other cases a kink of the Fallopian tube is the primary cause of retention, followed by a greater weight. The greater weight increases the kink, and so the process continues, while the lumen grows steadily smaller, and the accumulation of secretion more abundant.

**Disorders of Pregnancy and Parturition.** A mechanical disorder in which there is mutuality of cause and effect may be brought about when a retroverted gravid uterus is so impacted in the pelvis as to press on the urethra and cause retention of urine. The distended bladder increases the retroversion ; the retroversion increases the retention (Plate VII. f).

Matthews Duncan writes :

“ In cases of retroversion of the gravid uterus the retention of urine is both cause and effect. In other words there is in this disease what is sometimes called a Vicious Circle. . . . The replete bladder increases the retroversion and makes it, for the time at least, incurable, and it was the retroversion that made the retention of urine by pressure on the urethra. So the

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<sup>1</sup> An illustration of this state of strangulation is given by Herman and Maxwell. *Diseases of Women*, p. 112.

<sup>2</sup> *Disorders of the Sexual Function*, p. 183.



first is the cause of the second, and the second is, inversely, the cause of the first, both combining to form a Vicious Circle. In this kind of retention there is frequently, and probably always, a kind of insipid diabetes present."<sup>1</sup>

Congestion of, and hæmorrhage into, the decidua may also establish a pernicious circular reaction. Such hæmorrhage is very apt to cause detachment of the decidua and this in turn promotes further hæmorrhage. Abortion frequently results from the process, which is frequently associated with impaction of the gravid uterus.

Küstner writes :

"The broad ligaments are twisted, . . . the thin-walled veins are compressed and their lumen diminished, resulting in congestion of the uterus. This congestion is probably the usual cause of the interruption of the pregnancy that so often takes place and of the abortion that so often follows spontaneously. The congestion leads to hæmorrhages in the decidua. These, although slight at the outset, lead to further damage to tissues, and this in turn to further hæmorrhage, until the Vicious Circle of a commencing abortion is established."<sup>2</sup>

Where there is a threatened abortion the portion of ovum that is first detached may act somewhat like a foreign body and provoke uterine contractions which cause further detachment and so on until abortion is complete.

According to Fuchs a process of reciprocation may be observed in cases where an unusually large fœtus is associated with partus serotinus or deferred delivery. The dimensions of the giant fœtus compel almost complete physical repose of the mother

<sup>1</sup> Clinical Lectures on the Diseases of Women, p. 78. Cf. also Pouliot, *Annales des Maladies Génito-Urinaires*, 1909, p. 5.

<sup>2</sup> Veit, *Handbuch der Gynäkologie*, I., p. 248.

during the last weeks of her pregnancy, which repose further contributes to the foetal growth.

Fuchs writes :

“ The primary dimensions of the foetus compel the pregnant woman to a life of complete repose while such repose promotes the further enlargement of the child, thus completing the *circulus vitiosus*.”<sup>1</sup>

Asphyxia neonatorum is frequently complicated by what Lenzmann terms “ a very grave Vicious Circle.” This will be described in Chapter XVII.

Uterine inertia after delivery sometimes perpetuates itself as a result of the secondary distention of the uterus with blood. The condition is especially liable to occur if there is any neglect in the supervision of the uterus after delivery. The uterus may then fill with blood without there being any external appearance of hæmorrhage and the inertia is thus maintained.<sup>2</sup>

Another post-partum complication may be associated with uterine inversion, when the fundus is indented so as to project into the uterine cavity like a polypus. For the inverted portion may then provoke contractions which increase the inversion, the remainder of the process being completed by the uterus itself, which, so to speak, swallows the indented portion.<sup>3</sup>

Eclampsia is discussed on p. 68.

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<sup>1</sup> *Münchener med. Wochenschrift*, 1903, p. 1462.

<sup>2</sup> Eden, *Midwifery*, p. 518.

<sup>3</sup> A similar process is sometimes observed when a submucous fibroid projects into the cavity of the uterus. Herman and Maxwell, *Diseases of Women*, p. 313.

# Chapter Nine

## CONSTITUTIONAL DISEASES



UNDER this heading will be described some pernicious circular reactions associated with constitutional diseases, including :

- I. Obesity
- II. Diabetes
- III. Rickets

### I. OBESITY

Obesity may be defined as the condition which results from long continued excess in the amount of food consumed over that katabolised ; it becomes pathological when it interferes with functional activity. In its severe form obesity tends to affect almost every function of the body, and, owing to what Dyce Duckworth calls the "Vicious Circle of malign events," spells disaster to its victim. For convenience sake disorders of the cardio-vascular, the respiratory, the digestive, the nervous, the muscular and other systems will be dealt with separately.<sup>1</sup>

#### (a) Cardio-Vascular Disorders

Cardio-vascular disorders result from the extra strain thrown on the heart and the blood-vessels, and do much to aggravate the primary evil. In

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<sup>1</sup>For further details cf. Obesity and its Vicious Circles, by J.B.H., *Practitioner*, 1917, II., p. 164.

health the weight of the cardiac muscle is roughly in proportion to the weight of the body. In corpulence, however, this proportion is disturbed owing to the excess of adipose tissue, and an increased burden is imposed on the myocardium. In order to cope with this extra work the heart undergoes a beneficent hypertrophy, and under favourable circumstances can for many a long year meet the unusual demands made upon it. Sooner or later, however, the hypertrophied heart tends to insufficiency, the time when such insufficiency manifests itself depending much on the mode of life. As the cardiac decompensation progresses, the left ventricle can no longer drive the whole of its contents into the aorta, and the familiar conditions of venous stasis gradually supervene. These unfortunately react on the heart, and the circular reaction of heart failure and venous stasis is established.

The result is a serious interference with the activities of life. Consciously or unconsciously such tasks as cause discomfort are avoided, and the muscular work accomplished is greatly diminished. This aggravates the primary evil.

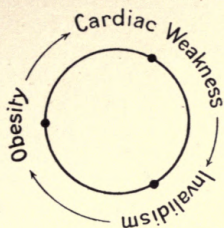
Von Noorden writes :

“ Obesity makes great demands on the functional activities of the heart and blood-vessels, leading to excessive strain and weakness. Conversely every primary cardio-vascular disorder *cæteris paribus* is more dangerous in a corpulent than in a thin patient. As a result of this injurious Vicious Circle a large proportion of corpulent persons sooner or later, slowly or rapidly, present signs of cardiac failure and chronic blood-stasis ; in the long run most stout persons die of cardiac failure.”<sup>1</sup>

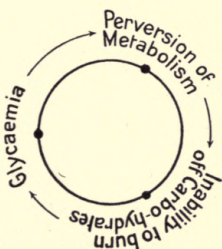
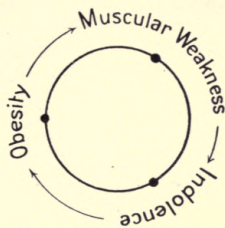
Not only does obesity affect the heart through the increased burden imposed ; there are other directly

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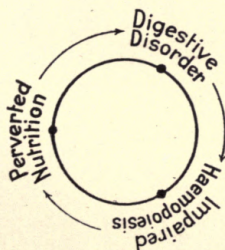
<sup>1</sup> Die Fettsucht, p. 30.



(a) OBESITY



(b) DIABETES



(c) RICKETS

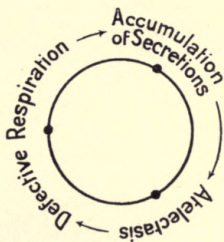


Plate VIII.—Circles associated with Constitutional Diseases.



injurious effects. Fat may accumulate in the heart in two ways. In the first place there may be extensive deposits beneath the pericardium, along the auriculo-ventricular and inter-ventricular sulci, between the strands of muscle and even beneath the endocardium; sometimes the weight of such deposits exceeds that of the muscular tissue itself. Fat may also be deposited in the mediastina and these deposits combine with those in the heart itself to interfere with the cardiac movements and aggravate the myocardial incompetence of the obese. In the second place in fatty degeneration fat is deposited as fine droplets within the cardiac muscle-cells. Hence results a weakened systole and a lessened power of resistance. These injurious effects of obesity are of course intensified when fatty infiltration and degeneration co-exist. The associated symptoms appear earlier as well as in greater urgency and tend to aggravate the obesity. The *corpus adiposum* leads to the *cor adiposum* and *vice versa* (Plate VIII. a).

Much the same sequence is observed when some cardiac disorder supervenes in a healthy person. Such disorder obliges the cardiopath to renounce all laborious work, thus favouring the accumulation of fat, imposing a further burden on the heart and increasing the risk of failure.

Von Noorden writes :

“ Cardio-vascular disorders lead to corpulence, and the corpulence accelerates the cardiac failure, thus giving rise to a most pernicious Circle (*verderbliche Wechselwirkung*).”<sup>1</sup>

Arterio-sclerosis and chronic interstitial nephritis are frequent complications of obesity, and in time recoil on the heart and eventually on the obesity. The sclerotic changes are especially prone to invade

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<sup>1</sup> Die Fettsucht, p. 98.

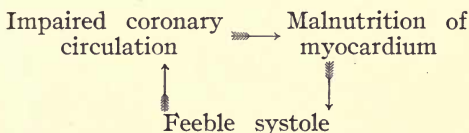
and narrow the coronary arteries, leading to ischæmia, degenerative myocarditis and further weakening of the coronary circulation.<sup>1</sup>

Warfield writes :

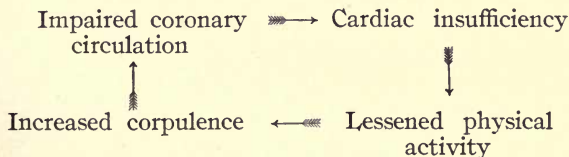
“The primary change is an increased tension in the arterioles which later leads to thickening of the coats of the vessels and to the other consequences of arterial disease. A Vicious Circle is thus established which has a tendency to become progressively worse.”<sup>2</sup>

Such cardiac insufficiency greatly curtails all forms of physical exercise with the result of increased corpulence. The interference with the coronary circulation due to corpulence may in fact create two concurrent Circles, one of short (A), the other of longer circuit (B) :

## A.



## B.



Obese persons frequently suffer from anæmia, due to the lessened amount of hæmoglobin associated with decreased absorption of oxygen and a

<sup>1</sup> Kisch, Die Fettleibigkeit, pp. 116, 145.

<sup>2</sup> Arterio-sclerosis, pp. 87, 113, 163.

slowing of the oxidation processes. The resulting symptoms are shortness of breath, giddiness, tinnitus, palpitations and a tendency to temporary anasarca. All these troubles tend to indolence and so favour corpulence.

### (b) Respiratory Disorders

Various respiratory disorders result from, and in turn promote, obesity. For example, the thoracic cavity may be encroached upon by fatty cushions in the mediastina and by the fatty enlarged heart ; the respiratory muscles and ribs may be overweighted with fat and unable to expand the thoracic walls efficiently ; the diaphragmatic pump may be unequal to the task of forcing down the fatty viscera in the abdomen, which is itself encroached upon by extensive and unyielding accumulations of fat. Thus both the respiratory capacity of the chest and the respiratory movements of the lungs are restricted ; the patient quickly becomes dyspnoëic on slight provocation. These conditions tend to shallow breathing movements, and the more superficial the respiration, the less the negative pressure in the chest, and the less the assistance given to the return of venous blood to the heart and to the pulmonary circulation.

The shallower the respiratory movements the slower the rate of oxidation ; the fat-forming substances are less perfectly burned up and are more largely deposited as fat, all these conditions being closely linked in reciprocal correlations.

Increase of obesity is also favoured by the impaired respiration leading to hypertrophy and dilatation of the right heart with their influence on venous stasis and impeded oxygenation.

Campbell writes :

“ Since obesity restricts both costal and diaphragmatic movement, and at the same time curtails the

respiratory area, it necessarily impedes the circulation, causing the blood to flow with increased difficulty through the lungs. Hence the tendency to hypertrophy and dilatation of the right heart in the obese, and for the blood to be dammed back upon the great veins. The circulation being sluggish and the respiratory action curtailed, the further formation of fat is favoured. Thus fat begets fat.”<sup>1</sup>

Feeble respiratory movements from these or other causes lead to defective nutrition of the lungs, since such nutrition largely depends on adequate movements; impaired pulmonary nutrition in its turn tends to feeble movements.

Another consequence of impaired movement and imperfect aëration is increased liability to bronchial catarrh, which tends to become chronic and further to impede oxygenation. The associated cough is less effective in expelling pulmonary and bronchial secretions. Chronic bronchitis and emphysema are frequent and self-aggravating sequelæ. Corpulent persons are bad breathers.

These pulmonary disorders curtail physical activity. Every exertion that embarrasses breathing is gradually abandoned and such diminished exercise in its turn favours corpulence.

### (c) Digestive Disorders

We may deal in order with the stomach, the liver and the bowels.

In health an automatic self-regulating mechanism of great accuracy governs the daily imports and exports of the body. This mechanism leads the individual unconsciously to adopt a maintenance diet, i.e. the quantity and kind of food on which imports and exports are in equilibrium, and on which an average weight is maintained.

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<sup>1</sup> Respiratory Exercises in the Treatment of Disease, p. 137.

Under various conditions, however, this mechanism is thrown out of gear ; appetite ceases to be a trustworthy guide, and more food is consumed than is required for the nutrition of the body.<sup>1</sup>

In obesity such a perverted appetite often leads to an excessive consumption of food. In fact boulimia may accompany a strong conviction that the appetite is in no way abnormal.

Again corpulence often creates a sense of exhaustion and the sufferer stuffs himself with food in the hope of obtaining relief. The result is in many cases gastrectasis with hunger-pain, followed by a ravenous appetite and further dilatation and obesity. This sense of exhaustion frequently leads obese persons to resort to alcoholic drinks, a remedy which is particularly insidious in such persons since the drinks are generally added to an already ample diet. Moreover alcohol promotes obesity through its ready oxidation ; it is a source of energy and a sparer of fat. According to von Noorden one gram. of alcohol, with a physiological value of 7 calories, saves the body .75 gram. of fat or 1.7 gram. of carbohydrate. When it is remembered how many people take 50 gram. of alcohol a day and even much more, the important rôle played by alcohol in promoting obesity is evident.<sup>2</sup> Corpulence and alcoholism reciprocally favour each other.

Craving for food is also largely dependent on habit. If the stomach is accustomed to a high degree of repletion a meal does not yield full satis-

<sup>1</sup> Obese persons need relatively less food than others. About 26-36 calories per kilo. of body-weight suffice, instead of the normal 34-45 calories. This is due to the relatively small surface of their body, to the smaller loss of heat, to the fact that fat does not consume energy, and to the less amount of exercise usually taken.

<sup>2</sup> Von Noorden, *Die Fettsucht*, p. 28.



faction until the customary distention has been reached. Heavy meals tend to become habitual.

As a result of boulimia some obese persons become plethoric, and not anæmic as occurs under other circumstances. Their blood is rich both in red cells and in hæmoglobin; their circulatory and digestive systems are usually active. These conditions aid and abet each other. For some years such persons may enjoy robust health and unusual powers of work. There is, however, always a tendency to sclerotic changes and eventually to cardiac failure.

Martinet describes the correlations :

“ The over-nutrition leads to a state of plethora with its concomitants, and is associated with an abnormal activity of the vascular and renal systems. The active circulation excites more copious digestive secretions and these again maintain the over-nutrition. A Vicious Circle is thus established.”<sup>1</sup>

The viscera are apt to become the seat of fatty deposits in obese persons ; such a condition tends to indolence and favours the increase of obesity. An excellent illustration of this is presented by the liver which may become greatly enlarged and weigh many pounds more than the healthy organ. The proportion of the fat may rise from the normal of 1-4 p.c. of the hepatic tissue to 30 or even 80 p.c.<sup>2</sup> Moreover as soon as the obesity has led to venous stasis, a fresh factor is introduced which affects the whole portal area, leading to increased weight of the body, impaired activity and further corpulence.

Constipation is another complication resulting from, and in turn favouring, obesity. Peristaltic movements are impeded, the abdominal muscles are weakened and physical activity is lessened.

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<sup>1</sup> Pressions Artérielles et Viscosité Sanguine, p. 226.

<sup>2</sup> Bouchard and Brissaud, *Traité de Médecine*, I., p. 424.

The progress of the intestinal contents is slowed, and a larger proportion of the ingesta is absorbed. All these factors aggravate obesity.<sup>1</sup>

Krehl thus sums up the cumulative effect of the various conditions :

"These causes, singly or together, are responsible for most cases of obesity. It is merely a problem in arithmetic. A certain amount of energy is taken in the form of food, a certain amount is lost as heat and work, and the remainder is stored up in the body mainly as fat. As soon as the accumulation of fat begins to deter the patient from taking exercise, a Vicious Circle is established and he tends to increase in weight more and more."<sup>2</sup>

#### (d) Nervous Disorders

Corpulence is frequently associated with a sluggish nervous system, although this relation is by no means constant ; many obese persons are mentally and physically active and get through a large amount of work.

Von Noorden writes :

"Nervous and physical indolence often long precede corpulence, but they favour its onset and accelerate its progress. On the other hand the corpulence in its turn acts as an additional cause for indolence and inactivity."<sup>3</sup>

In other cases corpulence is independent both of excess of diet and of deficiency of exercise, and

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<sup>1</sup>H. Lohrlich found that in a diet with an energy value of 7,000 calories about 270 calories are lost in the fæces of a person with regular action of the bowels, while only 170 calories are lost in a constipated person. *Deutsch. Archiv f. klin. Medizin*, LXXIX. (1904), p. 383. Cf. also *Medizinische Klinik*, V. (1909), p. 439.

<sup>2</sup>Basis of Symptoms, p. 315.

<sup>3</sup>Die Fettsucht, p. 79.

results from retarded katabolism due to such conditions as hypothyroidism and hypopituitarism (endogenous obesity). The correlations are obscure, but it seems probable that hypothyroidism and hypopituitarism, possibly associated with some form of toxæmia, may in turn react on nervous functions, thus perpetuating the disorder.

Many obese persons sleep abnormally long, even as much as ten or twelve hours a day. This excessive somnolence may be due to a chronic carbonæmia dependent on cardiac insufficiency, diminished respiratory capacity or defective diaphragmatic activity. Whatever the cause, such somnolence favours corpulence since only about half as many calories are expended during sleep as during work. Löbisch estimates that an obese person who, without otherwise changing his diet or mode of life, increases his hours of sleep from seven to eight adds 1043·9 gm. of fat during the year. From 8·2–8·5 gm. less CO<sub>2</sub> per hour is excreted by a sleeping than by a waking person.<sup>1</sup>

Other complications are superadded when corpulence is complicated by cardiac insufficiency, since the voluntary effort required to keep up active habits involves heavy drafts on the reserve energy. The necessary strength of will is usually either lacking, or is exerted at such cost that exhaustion supervenes before enough muscular work has been performed to influence metabolism. The greater the sense of weakness the greater the effort required and the less can be accomplished.

Various other nervous symptoms may be present, such as giddiness, tinnitus and *muscæ volitantes*, all of which tend to lower self-confidence and impair physical activity. They are probably dependent on deficient blood-supply to the nerve centres.

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<sup>1</sup> Kisch, *Die Fettleibigkeit*, p. 17.

## (e) Cutaneous and Sexual Disorders

Both the cutaneous and sexual systems are affected by corpulence and the resulting disorders may aggravate the primary trouble. For instance, deposits of subcutaneous fat diminish the amount of heat given off by radiation and conduction, and conserve the body heat. The result is a lowered metabolism of heat-producing materials and a tendency to increased corpulence. A further effect is sluggishness of the heat-regulating mechanism. The superficial area of the body is smaller in a corpulent than in a spare person in proportion to the weight ; this tends to check the loss of heat, while pyrexia is more obstinate and involves greater peril.

On the other hand under the influence of muscular exercise or of emotion, perspiration and evaporation are more active in obesity. Many corpulent persons are like Falstaff "subject to heat as butter . . . in continual dissolution and thaw."<sup>1</sup> Unfortunately, however, such profuse perspiration leads to much discomfort and diminishes inclination for exercise, thus tending to increased corpulence and hyperhidrosis.<sup>2</sup>

Hewlett writes :

"The outlook for a spontaneous cure of obesity is not good. As obesity increases the avoidance of exercise becomes more and more necessary, on account of the increasing tendency to sweating and the shortness of breath on exertion. A Vicious Circle is thus established, for the increasing weight limits the exercise, and the limited exercise tends to increase the weight."<sup>3</sup>

This liability to profuse perspiration is specially marked in moist warm climates such as are often

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<sup>1</sup>Merry Wives of Windsor, III., v.

<sup>2</sup>Von Noorden gives a table shewing the great difference in the amount of perspiration in thin and stout persons. *Die Fettsucht*, p. 114.

<sup>3</sup>Musser and Kelly, *Practical Treatment*, III., p. 52.

found in the tropics, and accounts for the inability of stout persons to undertake physical exercise. At times the excessive moisture causes maceration of the skin of the soles and tenderness of the feet. Walking becomes painful and this favours progressive obesity.

Fat women sometimes suffer from vulvitis and excoriations of the nymphæ which may be associated with difficulty in the removal of smegma. Such vulvitis may cause exercise to be restricted within the narrowest limits.

The excretion of fat *via* the sebaceous glands is less active in corpulent than in normal persons, if some observations by Leubuscher are to be relied upon. This factor must tend to perpetuate obesity.<sup>1</sup>

The sexual appetite is distinctly lowered in obese persons according to Dyce Duckworth.<sup>2</sup> On the other hand inertness of the sexual organs may in its turn favour the deposition of fat ; this correlation, however, is by no means a constant one.

#### (f) Muscular Disorders

Important correlations connect corpulence with the muscular system.

Adami writes :

“The accumulation of fat in the tissues, when extreme, hinders activity, and, doing this, brings about diminished oxidation, thus setting up a Vicious Circle.”<sup>3</sup>

During the earlier half of life increase of fat appears usually to lead to an associated growth of muscle fibre. But this beneficent relation ceases as the years roll by, and muscular development no longer keeps pace with advancing adiposity. On the contrary the obese person needs to expend greater

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<sup>1</sup> XVII. Kongress f. innere Medizin (1899), p. 457.

<sup>2</sup> Allbutt and Rolleston, System of Medicine, IV., p. 493.

<sup>3</sup> Principles of Pathology, I., p. 379.



effort in the performance of physical work, consequently he tires more easily and seeks to avoid exertion. The more he weighs the less he exercises ; the less he exercises the more he weighs (**Plate VIII.a**).

Gilford describes the correlation :

“ Muscular correlation is sometimes very defective, especially when fatness sets in after middle age, when the muscular system is no longer able to rise to the occasion. A Vicious Circle is often established. The tired muscles insist upon rest, but more rest means more fat, and so the inadequacy of the muscles is still further increased.”<sup>1</sup>

As a rule the muscular system, both voluntary and involuntary, is under-developed and weak in stout persons, who too often neglect to take the exercise which is so necessary if the tendency to corpulence is to be checked.

Von Noorden writes :

“ As a rule stout persons do not exercise their muscles sufficiently to bring those muscles and the myocardium into relation with the demands made on them by the increased weight of their body. Even if they try to do so, their weight frequently increases so rapidly that the adaptation of the voluntary muscles and still less of the cardiac muscle cannot keep pace with it. Moreover in the case of those numerous persons whose cardiovascular system is naturally somewhat under-developed, the progressive adaptation of the heart ceases at an early age. Here then is a form of *circulus vitiosus*. Persons with a feeble circulatory system give up active habits at an early age (i.e. soon after the close of adolescence) and pave the way for obesity (exogenous obesity from inactivity). The further this advances (many conditions may contribute), the greater becomes the maladjustment between the vigour of the heart and the weight of their body.”<sup>2</sup>

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<sup>1</sup> Disorders of Post-Natal Growth and Development, p. 515.

This Circle is illustrated by J. S. Kellett Smith. The Cure of Obesity and Obese Heart, p. 64.

<sup>2</sup> Die Fettsucht, p. 85.

Even more serious is this condition in elderly persons whose recuperative powers are greatly reduced.

Von Koranyi writes :

“When in elderly persons changes and disorders of the organs of locomotion, of circulation, of respiration and of the nervous system lead to diminished exercise and consequent obesity, a Vicious Circle is established. For such increase in weight leads in turn to further restriction, loss of power of locomotion, and to progressive disorder of the circulation and respiration.”<sup>1</sup>

In advanced cases of obesity the unusual efforts required by the lumbar and sacral muscles in order to maintain the erect posture induce persistent back-ache which interferes much with locomotion and leads to an indolent life on the sofa. Somewhat allied to these incapacitating conditions are sprains, muscular stiffness and flat foot. Flat foot frequently results from, and aggravates, obesity. There is also “the obese patient with enlarged, grating and painful knee joints, which limit activity and so help to complete a Vicious Circle.”<sup>2</sup>

## II. DIABETES

Diabetes may be complicated by several self-aggravating conditions.

In some forms of the disease the ingestion of sugar diminishes the power of the diabetic to split up the molecule of glucose. Thus the consumption of a definite quantity of sugar may lead to the elimination in the urine of a larger quantity than has been consumed. In other words the increased glycæmia reduces the power of burning up sugar.

Allen has proposed to use this observation as a means of distinguishing diabetes from glycosuria, and has formulated the following law : “In normal

<sup>1</sup>Schwalbe, Lehrbuch der Greisenkrankheiten, p. 719.

<sup>2</sup>Kellett Smith, The Cure of Obesity and Obese Heart, p. 62.

individuals the more sugar is given the more is utilised, while the reverse is true in diabetes."

Another circular reaction may be established as a result of inadequate nutrition in cases of severe glycaemia. Metabolism may indeed be so greatly disturbed that the administration of carbo-hydrates is required in order to prevent rapid inanition. The carbo-hydrates in their turn intensify the glycaemia and increase the inanition which requires further administration of carbo-hydrates (**Plate VIII. b**). In these cases the amount of carbo-hydrate that can be utilised must be carefully ascertained so that the patient receives this amount and no more, otherwise the glycosuria may actually be aggravated.

Pick and Hecht thus allude to this process :

"Strict individualisation and constant regulation of the diet, with control of the general symptoms, and exact quantitative determination of the urinary constituents, often permit us to avoid the dangers of this Vicious Circle."<sup>1</sup>

Many physiologists hold that there is a constant tendency of the liver to convert glycogen into sugar through the action of a diastatic or glycogenolytic ferment, which tendency is held in check by an inhibitory mechanism controlled from a centre in the floor of the fourth ventricle. If this is so, it seems not unlikely the nutritive disorders resulting from chronic diabetes may weaken this inhibitory mechanism and perpetuate the glycosuria. On this theory the gradual increase of diabetes would also be explained.

Again in cases of chronic hyperglycaemia the kidneys lose somewhat of their fine sensitiveness to increase in the blood sugar, and the degree of hyperglycaemia tends to rise progressively.

### III. RICKETS

Rickets is believed to be due to defective and

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<sup>1</sup>Clinical Symptomatology, p. 592.

perverted nutrition, mainly caused by an insufficient supply of animal fat and of earthy salts in the form of phosphates, combined in many cases with a shortage of animal protein. The result is a general disorder of a large number of the tissues and structures of the body, including the nervous, respiratory, digestive, hæmopoietic and muscular systems. These disorders acting cumulatively aggravate and perpetuate the processes of malnutrition. The sequence of events doubtless varies under different circumstances.

At times the digestive system is chiefly disturbed, leading to fermentation, flatulence and catarrh of the digestive tract, which seriously affect assimilation and intensify the primary disorder (**Plate VIII. c**).

In other cases the liver and nervous system bear the brunt of the disorder.

Pritchard writes :

“ The pathogenesis of the disease thus defined must be regarded as a Vicious Cycle of events in which each individual link in the chain acts and reacts on the others. In describing this Vicious Cycle it is difficult to know at what point to begin ; indeed, in the production of rickets there is no starting-point ; the disease may start in a variety of ways.

The Vicious Cycle may be briefly described as consisting of an inefficient liver associated with a disturbed central nervous system acting and reacting on one another.

These are the two pathological pivots on which, according to my view, the symptoms mainly hinge.

The liver may be primarily damaged by faulty methods of feeding, from abuse of its functions, or from overwork, or it may be inherently or congenitally weak. As a rule there is first indigestion, with the formation of toxic products of indigestion, then efforts on the part of the liver to oxidize or destroy these products, then collapse or failure of liver function with the escape of these unoxidized products into the general circulation, and finally poisoning of the nervous system itself.

Poisoning of the nervous system, from whatever cause induced, not only intensifies the liver inefficiency by interfering with its nervous mechanism, but it also

leads to incapacity of other furnaces in the body, and herein lies the essence of the Vicious Cycle of events.”<sup>1</sup>

The respiratory mechanism is especially involved in some forms of rickets. This mechanism is always functionally weak, and where the ribs are much deformed a line of depression may be seen running transversely across the chest from the lower end of the sternum, and corresponding roughly to the line of attachment of the diaphragm. Even in ordinary inspiration and still more when there is any obstruction to breathing the chest may be drawn in during inspiration along this line, thus interfering with oxygenation.

Beneath this line patches of collapsed lung are often found, and such collapse by producing dyspnoea may lead to further drawing in of the ribs and thus aggravate the collapse. This sequence is frequently observed in the bronchitis which is so frequent a complication of rickets (**Plate VIII. c**).

Still writes :

“Bronchitis is very frequent in rachitic children and this tendency is favoured, in severe cases, by the softness of the ribs and the weakness of the respiratory muscles. There is, in fact, a Vicious Circle. For mechanical reasons the lung is very imperfectly filled with air and the collapse thus induced favours the occurrence of bronchitis and hence further collapse.”<sup>2</sup>

The thoracic deformity of rickets appears at times to be not merely a result of softening, but also a cause of further softening owing to the continued irritation.

McKenzie writes :

“It is a well-recognised fact that the rickety deformity manifests itself most in those parts exposed to mechanical strain. The mechanical strain produces a deformity in the first place and in the second excites further rachitic softening by its irritation, thus producing for a time a Vicious Cycle of events.”<sup>3</sup>

<sup>1</sup> The Infant, p. 234.

<sup>2</sup> Osler and Macrae, System of Medicine, I., p. 884.

<sup>3</sup> *British Med. J.*, 1911, I., p. 930.



# Chapter Ten

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## THE EYES AND EYE-LIDS



DISORDERS associated with the eyes may conveniently be discussed under the following headings, although the classification cannot always be strictly adhered to :

- I. The Eyes
- II. The Eye-lids
- III. Errors of Refraction
- IV. Neuroses

### I. THE EYES

**Conjunctivitis.** Conjunctivitis gives rise to various secondary conditions which perpetuate the conjunctivitis. One of the commonest of these is blepharospasm which may accompany any form of conjunctival inflammation. By its means irritant secretions are pent up and their retention perpetuates the irritation.

Perhaps the severest form of blepharospasm is met with in the phlyctenular conjunctivitis of children. The lids are kept tightly closed for hours together, thus retaining the discharges in prolonged contact with the inflamed surfaces. Moreover the exclusion of light renders the retina more and more sensitive, and this factor also tends to intensify the blepharospasm.

In some forms of conjunctivitis the discharges are highly virulent, as for example in ophthalmia neonatorum and gonorrhœal ophthalmia. The irritating secretions may also be confined under consider-

able pressure and such pressure increases their deleterious action.

Blepharospasm may also be associated with entropion which causes the inturned eye-lashes to irritate the inflamed conjunctiva and thus to perpetuate the ophthalmia. Such a condition is not uncommonly seen in children when a foreign body has lodged in the eye.

Other reciprocally acting conditions may complicate granular conjunctivitis or trachoma. The granulations are stated to be both cause and effect of the inflammation, each disorder contributing to the other.

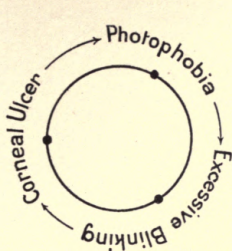
Burnett writes :

“ There has always been a question as to whether the granulations are the cause or the result of the inflammation. From the fact, however, that they have been found in eyes which have not been inflamed, it would appear more likely that the inflammation is not the first step in the process, though undoubtedly the inflammation, when it is once set up, facilitates its progress and encourages new deposits, and thus a Vicious Circle is completed.”<sup>1</sup>

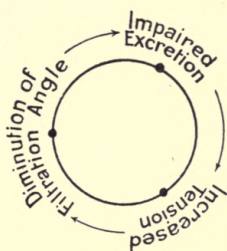
Conjunctivitis frequently depreciates the general health and thus delays recovery. For example, phlyctenular conjunctivitis is prevalent in ill-nourished strumous children who in order to escape all light remain indoors in darkened rooms, and bury their faces in cushions or under shawls. The seclusion from light, air and exercise lowers the already depressed nutrition and aggravates the disease. Again gonorrhœal conjunctivitis is often associated with extreme physical and mental depression caused by remorse and the anticipation of blindness. Such fears naturally lower vitality and retard processes of repair.

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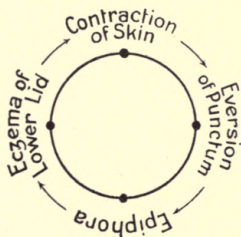
<sup>1</sup> Norris and Oliver, System of Diseases of the Eye, III., p. 209.



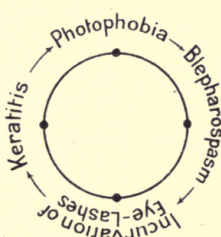
(a) CORNEAL ULCER



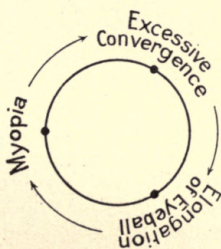
(b) GLAUCOMA



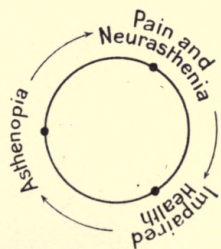
(c) ECTROPION



(d) ENTROPION



(e) MYOPIA



(f) ASTHENOPIA

Plate IX.—Circles associated with the Eyes.

**Keratitis.** Some of the circular reactions described in connection with conjunctivitis apply to keratitis. In fact conjunctivitis and keratitis are intimately associated, and the influence of blepharospasm in causing retention of secretions is equally injurious in both disorders.

Trichiasis due to entropion is especially dangerous when there is ulceration of the corneal surface, since the usual epithelial protection is lost.

Lawson writes :

“ The corneal inflammation causes great pain with photophobia and lachrymation, owing to which the patient keeps his eyes convulsively closed (blepharospasm), and by so doing causes a still greater approximation of the incurved lashes to the cornea, and establishes a Vicious Circle. If the condition is not relieved by artificial means matters will go from bad to worse, and in time the sight will be completely destroyed.”<sup>1</sup>

Another troublesome complication of corneal ulcer is incessant blinking, which causes the upper lid to rub against and irritate the inflamed surface and thus hinders repair (**Plate IX. a**).

Lawson writes :

“ The movement of the upper lid, by rubbing against and irritating the ulcerated surface, increases the pain and photophobia, and in this way keeps up a Vicious Circle, which is arrested by a light bandage.”<sup>2</sup>

In some cases of chronic keratitis the corneal tissues may be so softened and thinned as to be unable to resist the intra-ocular pressure. A staphyloma corneæ then results, with progressive bulging which causes further attenuation and further bulging.<sup>3</sup> A similar sequence is sometimes associated

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<sup>1</sup>Injuries and Diseases of the Eye, p. 459.

<sup>2</sup>*L.c.*, p. 145.

<sup>3</sup>Roemer, Text-Book of Ophthalmology, p. 532.

with keratoconus and scleral ectasiæ. These conditions will be further alluded to in connection with secondary glaucoma.

Corneal ulcer is another example of a chronic disease whose duration is prolonged by a depreciation of vitality. Such depreciation may keep up the local disorder and *vice versa*.

**Iritis.** A striking feature of iritis is its liability to establish a *locus minoris resistentiæ* with a strong tendency to relapse. This proclivity was formerly attributed to irritation caused by synechiæ. But the modern view is that recurrence results from the persistence of some such constitutional dyscrasia as may be caused by syphilis or rheumatism, and that the damaged iris constitutes a susceptible focus. With each attack a slighter provocation suffices for recrudescence.

**Glaucoma.** Glaucoma is frequently complicated by injurious circular reactions (**Plate IX. b**). In the words of Priestley Smith, "cause and effect react upon each other in a Vicious Circle and the glaucoma intensifies itself."<sup>1</sup>

In the healthy eye the intra-ocular fluid, after being secreted by the capillaries of the ciliary processes, passes into the posterior and then through the pupil into the anterior aqueous chamber, filters through the meshes of the ligamentum pectinatum and spaces of Fontana, and escapes into the canal of Schlemm and thence into the anterior ciliary veins, a state of equilibrium being maintained by a self-regulating mechanism.

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<sup>1</sup>Internation. Ophthalmologen Congress, Heidelberg, 1888, p. 243. Cf. also Norris and Oliver, System of Diseases of the Eye, III., p. 648. Pinto describes no less than five processes by which glaucoma may perpetuate itself. Encyclopédie Française d'Ophtalmologie, V., pp. 109, 113, 121, 124, 128,



In glaucoma this equilibrium is disturbed, with the result that the intra-ocular pressure rises. The exact mechanism, however, is not fully understood, and a variety of theories have been suggested.

According to the popular retention theory, the root of the iris, is under certain predisposing conditions, approximated to the root of the cornea, diminishing the filtration angle, hindering the escape of the intra-ocular fluid and raising the pressure in the whole eye-ball.<sup>1</sup> This impedes the flow of blood through the choroidal veins and adds to the congestion of the ciliary processes. As a result of these factors the increased quantity of intra-ocular fluid pushes forward the lens and iris, further blocking the filtration angle and checking excretion.<sup>2</sup>

Lawson writes :

"The sudden raising of the intra-ocular pressure increases the congestion, to be followed in its turn by a serous exudation from the venous channels, with a consequent further increase of pressure ; and thus a Vicious Circle is quickly established, with symptoms of ever-increasing violence."<sup>3</sup>

Kuschel believes that other factors contribute to the progressive increase of intra-ocular pressure :

"The increased pressure in the vitreous humour forces the coronary division of the hyaloid membrane

<sup>1</sup>The normal intra-ocular pressure of about 25 mm. Hg may in glaucoma rise to 60 mm.

<sup>2</sup>It is well to remember that correlations that appear to us injurious may with the progress of knowledge come to bear another explanation. Thus in 1867 Wecker suggested a different cause of glaucoma : "The diminished elasticity of the sclerotic plays a highly important rôle. It establishes a Vicious Circle in respect of the ciliary nerves, which are more and more compressed." *Maladies des Yeux*, I., p. 502.

<sup>3</sup>Diseases and Injuries of the Eye, p. 236. Cf. also Henderson, *Glaucoma*, p. 131,

(vorderer Grenzsicht) into the intervals between the ciliary folds (Ciliartäler) and thus blocks them. As a result fluid can no longer escape from the vitreous in consequence of which a further rise in pressure takes place, followed by a further blocking of the inter-ciliary spaces. The Vicious Circle thus established leads to an enormous increase of intra-vitreous pressure and to a complete arrest of the circulation of intra-ocular fluids."

And again :

"The increased tension in the vitreous exerts severe pressure on the choroid especially on its anterior section . . . Hence results partial or complete obstruction to the venous flow through the ciliary processes, whose veins open into the anterior venæ vorticosæ. The ciliary processes consequently become disturbed and encroach upon or even entirely obliterate the inter-ciliary spaces. In this way another Vicious Circle is established which must further raise the pressure in the vitreous."<sup>1</sup>

According to Fischer glaucoma is due to an abnormal absorption of water by the colloids contained in the eye. The resulting swelling of the colloids then compresses the blood-vessels passing into or out of the eye. Hence the glaucoma has a tendency to self-aggravation.<sup>2</sup>

Even so simple a disorder as eye-strain may at times suffice to start the morbid sequence of events, at any rate in a small eye that is so to speak predisposed by a hypertrophied ciliary muscle.

Clarke thus alludes to the ætiological factors :

"The congestion caused by the eye-strain leads to hyper-secretion, perhaps to a mild form of cyclitis :

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<sup>1</sup> Der Intra-Okulare Flüssigkeitsstrom in seinen Beziehungen zum biomechanischen Aufbau des Auges unter gesunden Verhältnissen, beim Glaukom und bei der Kurzsichtigkeit, pp. 120, 129.

<sup>2</sup> Œdema and Nephritis, pp. 7, 61, 653-4.

obstruction at the filtration angle takes place, tension goes up and a Vicious Circle is established. If the eye-strain is removed by correcting the error the attack may be indefinitely postponed.”<sup>1</sup>

In the later stages of glaucoma the walls of the eye-ball are gradually stretched and thinned, sometimes in the region of the equator, sometimes in the ciliary zone. These processes of stretching and thinning aid and abet each other, and occasionally end in rupture of the globe.

Reciprocal relations also complicate secondary glaucoma, as for example where staphyloma results from perforation of the cornea associated with cicatrization of the prolapsed iris. There is then more or less complete obliteration of the filtration angle, followed by increased tension and increased staphyloma.

The sequence is described by Fick :

“Staphyloma corneæ is a corneal scar which, with the adherent iris, bulges outward. . . . The adhesion of the iris to the cicatrizing cornea produces traction on the ciliary body, that vascular and nervous part of the inner tunic of the eye by which the aqueous humour is secreted. Irritation of the ciliary body—so it is assumed—increases secretion ; the internal pressure of the eye is thereby raised. This heightened tension pushes the scar forward with greater force ; the ciliary body is thereby still more dragged upon, with the consequence of shutting up the *circulus vitiosus*.”<sup>2</sup>

**Retinitis.** Various affections of the retina are liable to be complicated by harmful circular reactions. An example is met with in myopic persons with retinal hyperæsthesia and muscæ volitantes.

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<sup>1</sup> *Clinical J.*, XXXVI., p. 322.

<sup>2</sup> *Diseases of the Eye and Ophthalmoscopy*, p. 257.

Landolt writes :

“ The myope sees these phenomena with greater ease, because he is seldom adapted to the source of light. Moreover, when the myopia is pernicious, the sensitiveness of the retina undergoes, from the beginning, a pathological exaggeration. Later on, to these almost physiological corpuscles are added others which are due to the retinal and choroidal exudation. The latter are now more numerous, larger and more troublesome and disquieting to the patient. He ascribes to them all kinds of shapes, and never wearies of their description, which he willingly accompanies with a faithful sketch. This is a proof of the torments to which they subject him and of the anxiety with which he observes them. This observation itself places him in a Vicious Circle of action and reaction, for the more he pursues these phantoms, the more he is harassed by them, nothing being more fatiguing than the observation of such entoptic phenomena. Thus it is that they become a cause, both direct and indirect, of the weakening of the eyesight.”<sup>1</sup>

Various other local conditions arouse injurious auto-suggestions in neuropathic individuals and feed the neurosis. Thus a trifling hyperæsthesia may lead to the adoption of injudicious procedures, as for instance when recourse is had to tinted lenses and darkened rooms, which only serve to increase the trouble. Even apart from hyperæsthesia some persons wear tinted glasses, what Donders terms “conservative spectacles,” on account of their agreeable and soothing effect. Such glasses withdraw the healthy stimulus of white light, intensify the retinal sensitiveness, and thus create a permanent necessity for their employment.

A more serious disorder may be associated with papilloedema. The primary cause is usually found in an increase of intra-cranial pressure due to hydro-

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<sup>1</sup> Refraction and Accommodation of the Eye, p. 457.

cephalus or a new growth, which forces the subarachnoid fluid into the sheaths of the optic nerve. Hence result engorgement of the central vein of the retina, œdema of the optic nerve, and swelling of the papilla. The nerve becomes incarcerated at the point where it fits tightly in the foramen scleræ, and causes strangulation of the papilla and further engorgement in the vein. The œdema provokes strangulation and the strangulation œdema.

**Dacryo-Cystitis.** An injurious reciprocation may occur in cases of dacryo-cystitis owing to stricture of the lachrymal duct. The trouble begins with congestion of the lachrymal sac, causing some obstruction of the duct, which in turn is followed by excessive flow, stagnation and decomposition of the secretions. The consequent irritation produces further narrowing, often ending in complete obstruction.

Evans writes :

“The irritation of the sac and conjunctiva sets up an excessive reflex secretion of tears, and thus is established a Vicious Circle which perpetuates the inflammation and distension of the sac.”<sup>1</sup>

As a further result of the constant distention of the lachrymal sac by the fluid, the walls gradually lose their elasticity so that the tears no longer pass into the nose, even when the duct again becomes patent. The sac tends to grow steadily larger until a conspicuous fluctuating mucocele is produced.

## II. THE EYE-LIDS

The eye-lids have already been alluded to more than once as associated with diseases of the eyes. Some additional illustrations of circular reactions may be given under a special heading.

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<sup>1</sup> *British Med. J.*, 1907, I., p. 420.



**Ectropion.** Ectropion is a common self-perpetuating disorder which both results from, and provokes, epiphora ; any attack of persistent epiphora that produces a macerated and contracted state of the skin of the lower lid may start the process (**Plate IX. c**). The contraction of the skin draws down the margin of the lid and leads to eversion of the punctum, this being followed by increased epiphora.

Panas writes :

“ The skin, incessantly irritated by the tears flowing over it, contracts more and more, thus establishing a Vicious Circle which ends in ectropion.”<sup>1</sup>

An example of these correlations is met with in elderly persons in whom, owing to diminished elasticity of the skin, the lower lid is apt to drop away from the eye-ball, leaving the conjunctiva exposed. In course of time the conjunctiva undergoes hypertrophy and the increased weight leads to further displacement. The resulting epiphora is apt to provoke an eczematous condition of the lower lid (tinea or ophthalmia tarsi), and thus further aggravates the displacement.

Fuchs writes :

“ As a consequence of the wetting with the tears, the skin of the lower lid is attacked with eczema or becomes rigid and contracted, so that the free edge of the lid is no longer in perfect apposition with the eye-ball. As a result of this the punctum lacrimale no longer dips into the lacus lacrimalis, so that the transportation of the tears into the lachrymal sac is impeded, the epiphora increased, and thus again a still further injurious reaction upon the character of the skin is produced. In this way there is formed a Vicious Circle which leads to a constantly increasing depression of the lower lid (ectropion).”<sup>2</sup>

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<sup>1</sup> *Maladies des Yeux*, II., p. 333.

<sup>2</sup> *Text-Book of Ophthalmology*, p. 148. Cf. also Berry, *Diseases of the Eye*, p. 58.

In order to mop up his tears the sufferer usually wipes from above downwards and so increases the malposition ; a better plan is to wipe the face from below upwards so as to press the lid back into place.

Clarke writes :

“The causes of this eversion, which displaces the punctum, are many. Among the most common are chronic inflammation of the lid and conjunctiva, granular lids and blepharitis. The lid becomes thickened, the punctum is drawn away from the eye, epiphora results ; this causes irritation of the skin, which leads to contraction, causing more eversion, and in a very short time, through the Vicious Circle of events, a well-marked ectropion exists.”<sup>1</sup>

Bishop Harman also writes :

“There is set up a Vicious Circle. The blepharitis predisposes on even slight provocation to conjunctivitis and eczema of the skin, and these in turn exaggerate the blepharitis ; ultimately both cilia and Meibonian glands may be destroyed.”<sup>2</sup>

Prolonged epiphora may in itself lead to blepharitis since cicatricial tissue resulting from the blepharitis causes the conjunctiva to be drawn forwards over the lid, thus thickening its edge and preventing its close application to the eye-ball. As a result tears now run down over the lid and intensify the blepharitis. Tears in fact do no little damage to the eye.

Another form of ectropion sometimes occurs in connection with chemosis of the eye-lids, when the bulging conjunctiva stretches the ciliary portion of the orbicularis, the contraction of which causes eversion of the lid. The everted lid and contracting orbicularis then act like a ligature and aggravate the chemosis by strangulating the conjunctival veins.

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<sup>1</sup> *Clinical J.*, XVI., p. 67. Cf. also Roemer, *Text-Book of Ophthalmology*, p. 298.

<sup>2</sup> *L.c.*, XXVIII., p. 361.

A similar form of spastic ectropion not infrequently follows an attempt to open the palpebral fissure in a child with swollen lids and blepharospasm.

Weeks writes :

“ Examples of this form of ectropion are observed in infants with ophthalmia neonatorum. In attempts to treat the conjunctiva slight traction is made on the skin of the lids. The infant cries, blepharospasm is induced, and the lids, both upper and lower, become everted. With increase of spasm, venous congestion becomes marked, and the ectropion may be perpetuated. Ectropion formed in this way is complete.”<sup>1</sup>

**Entropion.** Entropion is frequently caused by incurvation of the lid margins through spasmodic contraction of the ciliary fibres of the orbicularis, and then perpetuates itself through the associated trichiasis (Plate IX. d). The condition is often seen under circumstances of relaxation and œdema of the skin and loss of subcutaneous fat ; thus it occurs after cataract extraction in old people.

Terson writes :

“ When once the displacement of the lid has occurred a Vicious Circle is established, for the subcutaneous œdema is increased by the irritation of the trichiasis and can only be arrested when the eye-lid has been replaced by traction.”<sup>2</sup>

Cicatricial entropion may be associated with contraction of the conjunctiva and cartilage ; the commissure is frequently narrowed, producing what is known as blepharophimosis and further increasing the tendency to inversion. Muscular spasm and trichiasis frequently act as aggravating factors.

In other cases of entropion with blepharospasm a superficial ulceration is caused by the folding of the skin at the outer canthus and by the

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<sup>1</sup>Treatise on Diseases of the Eye, p. 189.

<sup>2</sup>Encyclopédie Française d' Ophthalmologie, V., p. 505.

conjunctival discharges. This ulceration by reflex irritation increases the spasm and acts as an important factor in maintaining the irritation of the eye.

### III. ERRORS OF REFRACTION

Every error of refraction may at times be complicated by self-perpetuating factors. Many of these are associated with asthenopia.

**Myopia.** There has been much discussion as to the ætiology of myopia. There is general agreement that the disorder is acquired through elongation of the eye-ball, but doubt exists as to the cause of this elongation (**Plate IX. e**).

The older view attributed the elongation to pressure on the eye associated with convergence, the injury being most easily produced in children whose ocular tissues had not reached their full power of resistance. The greater the pressure the more the eye-ball tended to yield ; the more the eye-ball yielded the greater the convergence required for clear vision.

This view was held by Landolt who writes :

“ The influence of near work may manifest itself in different ways. It will be noticed even that the three principal modes of production of myopia that we have mentioned are so intimately related to each other that one of them necessarily suggests the others. Exaggeration of convergence leads to that of accommodation. The latter of itself alone, and also by the excessive nearness of the object which it necessitates, and the position which gives rise to cephalic hyperæmia, favours the production of choroiditis. The affection of the membranes of the fundus oculi entails a diminution of the acuteness of vision, which, in its turn, makes the gradual approach of the object and exaggeration of convergence obligatory.

Sometimes this Vicious Circle will be opened, on the contrary, by diminution of the acuteness of vision, and, at other times, by a spasm of accommodation. But at whatever point this wheel of misfortune

takes up the victim, he must go round with it, and will have to inexorably pass through the series of injurious influences, which reinforce each other to aggravate the evil. When we take into consideration this linking together of harmful causes, we are no longer surprised at the rapid and constant progress made by myopia in an eye which it has once attacked, especially when the latter has been, from birth, disposed to it, or is deprived of the ability to resist it.”<sup>1</sup>

There are, however, various objections to this explanation which has been to a large extent abandoned.

According to Eldridge Green myopia is probably due to some obstruction to the outflow of lymph into the lymph spaces of the optic nerve.<sup>2</sup> Such obstruction increases the intra-ocular tension, distends the sclerotic posteriorly where it is weakest and causes myopia by elongation of the eye-ball. Any great physical exertion or even violent coughing may cause such obstruction, and when once the sclerotic has given way, its resulting weakness will predispose to further yielding. The progressive nature of the disease is thus readily explained.

Myopia, when once established, often produces much local discomfort which affects the general health and lowers vitality, especially in the case of children and neuropathic individuals.

Lawson writes :

“The general health in young children often suffers greatly from the aching and general discomfort they experience, and in this way a Vicious Circle may be established which favours the rapid advance of the disease.”<sup>3</sup>

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<sup>1</sup> Refraction and Accommodation of the Eye, p. 454. Cf. also Noyes, Diseases of the Eye, p. 64 ; *Trans. of the Ophthalmological Society of the U.K.* (1907), XXVII., p. 12.

<sup>2</sup> *Lancet*, 1918, I., p. 137.

<sup>3</sup> Diseases and Injuries of the Eye, p. 67.



Myopia and spinal curvature also stand in reciprocal relation, if Liebreich's views may be accepted :

“Spinal curvature and short-sightedness seem to form a *circulus vitiosus*, in so far as short-sightedness produces curvature, and curvature favours short-sightedness ; while evidently the same bad arrangements are at the foundation of both these anomalies.”<sup>1</sup>

**Hypermetropia.** Hypermetropic asthenopia is frequently a self-aggravating disorder. The over-strained accommodation causes the removal of any small object looked at to a greater distance and thus leads to diminished acuity of vision. This latter compels the sufferer to attempt closer work, involving increased effort of accommodation. Thus the two factors of over-strained accommodation and indistinct vision react on each other.

**Presbyopia.** A similar complication comes into operation with the advent of presbyopia as a result of the effort to obtain distinct vision by accommodation. Owing to the great distance at which the presbyope reads, the retinal image is small and indistinct, and this tempts him to bring his work closer to his eyes. At the nearer distance, however, he overtaxes his accommodation, and this in return renders his work indistinct and again compels its removal.

**Anisometropia.** Another self-intensifying disorder is anisometropia caused by exhaustion of the fusion centre and of the muscles of accommodation. Each of these factors reacts injuriously on the other.

Doyne writes :

“The trouble arises from a Vicious Circle. The fusion centre demands clear images and makes demands on the lower centres which control the muscles of the

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<sup>1</sup>School Life in its Influence on Sight and Figure, p. 16.

eyes ; the muscles become exhausted, the images become indistinct and the fusion centre becomes more imperious, as its task becomes more difficult. Moreover, all these details are mainly subconscious and independent of the will.”<sup>1</sup>

Much the same correlations may complicate astigmatism. The associated eye-strain involves a serious drain on the vital forces and their diminution involves further eye-strain.

#### IV. NEUROSES

Various ocular neuroses have been already referred to in connection with special disorders. Such for example are the auto-suggestions connected with *muscæ volitantes* in the myope and the asthenopia which complicates so many errors of refraction. The latter neurosis is so important as to demand a further reference.

**Asthenopia.** Asthenopia is a wide-spread disorder, especially in young persons whose ocular tissues possess little power of resistance, or in neuropaths whose nervous capital is limited and readily used up. The weakened tissues of children are mainly concerned in progressive myopia, while neuropaths suffer most from astigmatism or anisometropia.

Asthenopia may show itself in various ways. At times there is a continual sense of fatigue, headache or photophobia, caused by the abnormal and sometimes unsymmetrical effort of the ciliary and other ocular muscles to secure accommodation and binocular vision. The necessary effort consumes much energy and soon brings on exhaustion (**Plate IX. f**). There is what Goodhart calls a want of “watts, ampères and volts of nervous energy.”<sup>2</sup>

In such a state of exhaustion increased effort is required both in order to correct refraction and to secure clear images, and still greater and wasteful

<sup>1</sup> *British Med. J.*, 1910, II., p. 363.

<sup>2</sup> *Lancet*, 1916, I., 1122.

expenditure results ; nervous bankruptcy may supervene. Insomnia occasionally constitutes an aggravating factor ; the restorative influence of sleep is then lost and the pernicious process is accelerated.

Clarke writes :

"Insomnia is a very prominent symptom of eye-strain and so a Vicious Circle is started. Eye-strain produces among other troubles insomnia, and insomnia in its turn aggravates the patient's condition, because the all-important restorative is wanting."<sup>1</sup>

In yet another group of cases asthenopia impairs the processes of digestion and assimilation. Vitality is depressed and this renders the nervous and muscular tissues still more vulnerable to the abnormal strain thrown upon them.

"There is a Vicious Circle of cause and effect. Eye-strain with its pain and nervous disturbances, produces interference with assimilation and nutrition, which in its turn so reduces the general physical condition as to induce an increase in the asthenopia."<sup>2</sup>

**Shell Shock.** The wide-spread use of high explosives in the recent war has supplied numerous examples of neuroses in soldiers suffering from shell shock. Such soldiers may complain of blindness although no injury can be discovered which would account for the loss of sight. By a process of suggestion the visual perception structures in the brain may have been dissociated from the nervous tracts conveying the light stimuli from the eyes. The man is blind because he believes he is blind and makes no attempt to use his eyes. Such auto-suggestions are of course commonest in individuals with neuropathic introspective proclivities. Similar dissociation processes may cause sufferers from severe shock to become deaf or mute.

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<sup>1</sup> *Practitioner*, 1911, I., p. 26.

<sup>2</sup> Norris and Oliver, *System of Diseases of the Eye*, IV., p. 405. Cf. also Gould, *British Med. J.*, 1903, II., p. 663.

## Chapter Eleven

### THE NOSE



THE rebellious character of many diseases of the nose is due to the presence of self-perpetuating conditions. Amongst them are variations in the calibre of the nasal passages, both in the direction of excess and deficiency. These will be dealt with first.

**Stenosis.** The nasal cavities form a rigid box with highly vascular walls through which flows a tidal current of air. If as a result of obstruction to this current the air tension is diminished the vascular walls become distended with blood and lymph, and so to speak a dry cupping process is initiated. If this process is long continued a chronic condition of congestion and catarrh will result, ending in a permanent vaso-motor paresis and hyperplasia.

Such primary obstruction may be due to a variety of causes including injury, neglected or recurrent colds and so forth. The mucosa is maintained in a state of congestion, loses its contractility and gradually undergoes hypertrophy. These conditions then aggravate the obstruction to which they were due.

Scanes Spicer writes :

“Causative stenosis is followed by hypertrophic catarrh. Hypertrophic catarrh causes increased obstruction, and so a Vicious Circle is created, the circumference of which is far-reaching and ever-widening.”<sup>1</sup>

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<sup>1</sup> *British Med. J.*, 1900, II., p. 346. Cf. also Gradle, *Diseases of the Nose, Pharynx and Ear*, p. 46.

Stenosis may also call forth other conditions which maintain the stenosis. Thus behind the point of obstruction the inspiratory pressure will be less than in a patent nostril and this diminished pressure perpetuates the turgescence and promotes further hypertrophy. Again when once established the stenosis interferes with the expulsion of secretions and favours an accumulation which increases the obstruction. Like all cavities lined with mucous membrane the nostrils tend to become narrowed when their drainage and ventilation are interfered with.

Yearsley writes :

“ Defective drainage of the nasal cavities predisposes to microbic infections and their resulting inflammations. Bacteria find a suitable nidus behind a septal deflection, and the result is that recurrent attacks of rhinitis occur, each attack leaving the patient with increased obstruction and greater tendency to fresh infection ; consequently a Vicious Circle is established of obstruction, defective drainage, rhinitis, increased obstruction. This is the mechanism by which patients with nasal obstruction are so frequently the victims of the common cold. But the results of the Vicious Circle are more far-reaching than may appear on the surface.”<sup>1</sup>

Deflection of the septum is another cause of stenosis on the convex side, since such deflection leads to diminished tension behind the obstruction and such diminution tends to increase the deflection.

Watson-Williams writes :

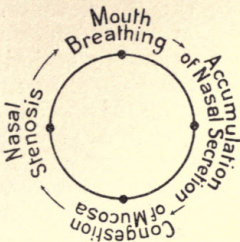
“ As a consequence of the partial nasal obstruction from deflected septum, inspiration causes a rarefaction of the air behind the obstruction ; as a consequence over-filling of the vessels and constant hyperæmia with chronic rhinitis and further increase of the nasal stenosis may result.”<sup>2</sup>

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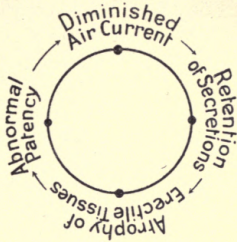
<sup>1</sup> *Practitioner*, 1914, II., p. 503.

<sup>2</sup> *Diseases of the Upper Respiratory Tract*, p. 337.

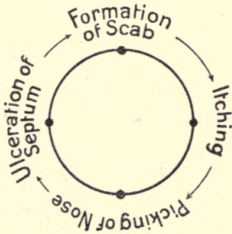




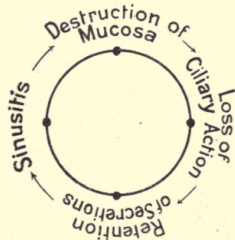
(a) NASAL STENOSIS



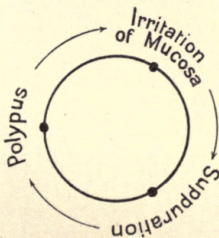
(b) NASAL DILATATION



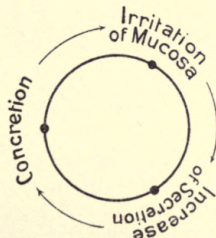
(c) ULCER OF SEPTUM



(d) SINUSITIS



(e) POLYPUS



(f) RHINOLITH

Plate X.—Circles associated with the Nose.

Riseley draws attention to the "Vicious Circle of events" which occurs when, owing to deformities of the scroll bones of the nostrils and to deviations of the septum or vomer, the nasal chamber is so narrowed that the opposing sides come into contact, or approach so nearly that any congestion of the lining mucosa brings them together. Here, too, a self-aggravating factor comes into play, since the opposing pressures perpetuate the congestion. Congestion breeds congestion. The nose is choked by the turgid soft tissues and drainage is checked.<sup>1</sup>

Obstruction is frequently caused by adenoids, which tend to enlarge as the result of the associated catarrh and infection.

Fraser writes :

"In case of adenoids a Vicious Circle is set up. The child suffers from attacks of coryza which cause enlargement of the naso-pharyngeal tonsil. This again gives rise to nasal obstruction and tends to keep up the catarrhal condition of the nose and naso-pharynx, and predisposes the child to fresh attacks of cold in the head."<sup>2</sup>

Adenoid growth is also favoured by the factor already alluded to, viz. the diminished barometric pressure accompanying the act of inspiration in cases of nasal obstruction. Every such act diminishes the pressure behind the obstruction, leads to hyperæmia and hyperplasia and so tends to further adenoid growth. Many children find it difficult to clear their naso-pharynx from the secretions produced by adenoids. These secretions then increase the irritation and further obstruct the naso-pharynx. Eventually the child is forced to breathe through

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<sup>1</sup> *British Med. J.*, 1906, II., p. 1869. Cf. also Ballenger, *Diseases of the Nose, Throat and Ear*, p. 142.

<sup>2</sup> *Encyclopædia Medica*, I., p. 169. Cf. also Crowley, *The Hygiene of School Life*, p. 38.

the mouth and this introduces a fresh factor which further intensifies the stenosis. In the absence of the normal currents of air through the nose secretions tend to accumulate and undergo decomposition, with the result that the mucous membrane is maintained in a state of chronic hyperæmia (Plate X. a).

As Mayo Collier says :

“Mouth-breathing introduces a further aggravating factor. A Vicious Circle is set up ; mouth-breathing tends to obstruct the nose, and this very obstruction maintains and continues the mouth-breathing.”<sup>1</sup>

Another sequence of reciprocal events may be observed in cases of enlarged tonsils, when these interfere with nasal, and thus conduce to oral, respiration. In mouth-breathers the hypertrophied tonsils are readily inoculated by any air-borne contagion, and then undergo further enlargement. Doubtless the enlargement is primarily a response to a demand for a greater leucocytic activity in order to get rid of microbial irritation and to that extent is a beneficent reaction. If, however, the enlargement is followed by mouth-breathing more harm is done than good, and the evil is aggravated.

Bloch writes :

“Enlarged tonsils frequently interfere with nasal respiration, and thus cause mouth-breathing, which in its turn acts injuriously on the tonsils that lie directly in the air-current. In fact these organs form the first important obstruction to the otherwise almost unimpeded current of air. They thus serve as the most convenient site for the deposition of the grosser impurities in the inspired air, and give rise to a true *circulus vitiosus*.”<sup>2</sup>

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<sup>1</sup>Mouth-breathing, p. 12. Cf. also Hogarth, Medical Inspection of Schools, p. 285.

<sup>2</sup>Die Pathologie und Therapie der Mundatmung, p. 73.

According to some writers adenoid vegetations through increased activity of the pharyngeal, mylohyoid and other muscles lead to contraction of the mandible and maxilla, and *vice versa*.

Pickerill writes :

“ A Vicious Circle originates in the following way :

1. A common cold causes blocking of the nasal cavities, swallowing efforts and contraction of the mandible.
2. The contracted mandible causes contraction of the maxilla.
3. The contracted maxilla causes contraction of the nasal cavities, and their further blocking by vegetation, and this leads to further strained deglutition.”<sup>1</sup>

Stenosis is liable to cause collapse of the alæ nasi. The sides of the nostrils then fall inwards on inspiration instead of expanding, and may convert the anterior nares into mere slits. In severe cases the alæ may actually fall against the septum.

Gradle writes :

“ Although itself the consequence of some intranasal anomaly causing stenosis, it (i.e. the collapse of the sides of the nose) intensifies the latter. With every inspiration the sides of the external nose sink in, thereby slightly narrowing the vestibule.”<sup>2</sup>

**Dilatation.** It is interesting to observe that abnormal nasal patency may also be a self-perpetuating condition (**Plate X. b**). This may be illustrated by the course of events in a case of atrophic rhinitis, a disorder which at any rate in its later stages is closely associated with undue patency of the nasal fossæ both as cause and effect. So wide is the nasal cavity as frequently to allow a clear view of the posterior wall of the pharynx.

<sup>1</sup> Dental Caries and Oral Sepsis, pp. 60, 64. Cf. also Stomatology, p. 28 ; *British Med. J.*, 1914, II., p. 1026.

<sup>2</sup> Diseases of the Nose, Pharynx and Ear, p. 196.

There is considerable difference of opinion as to the ætiological factors. In some cases atrophic rhinitis results from a diseased state of the nasal mucosa associated with deficient secretion and the formation of crusts. In other cases there has been deep ulceration or necrosis of bone or cartilage. But whatever may have been the primary cause atrophic rhinitis is characterised by wasting of the soft tissues lining the nasal fossæ as well as of the turbinated bones, combined with shrinking of the glands, fatty degeneration of their epithelium and diminution of the secretion. These conditions result in an abnormal width of the nasal passages from which in chronic cases the turbinates have almost vanished, leaving a dry, pale surface with adherent crusts.

As the velocity and force of a stream grow less with a wider channel so does the air passing through such dilated nasal passages lose the velocity and force required for the expulsion of tenacious nasal secretions. Hence the nasal fossæ are no longer swept clean by the usual tidal air currents and the secretions become inspissated and dry. The adhesiveness of the secretions is partly due to the ciliated epithelium having been replaced by squamous cells owing to the earlier rhinitis, partly also to the secretions contracting like a film of collodium, causing still further atrophy of the soft and bony tissues and still greater nasal patency. Thus the morbid process is perpetuated, and we have the paradoxical condition of dilatation preventing the removal of obstruction.

In many cases atrophic rhinitis is complicated by sinusitis, the two disorders favouring each other.

Adam writes :

“In most cases atrophic rhinitis is the end stage of a chronic hyperplastic purulent rhinitis, involving first the membrane, then in more than half the cases the sinuses. This sinusitis, by a Vicious Circle, reacts



on the membrane and perpetuates the inflammatory process there."<sup>1</sup>

In other cases the removal of a polypus seems to supply the primary stimulus to the degenerative changes.

MacDonald writes :

"After the removal of nasal polypi in cases where the inferior turbinals had previously presented a normal appearance, there is sometimes induced a mucopurulent discharge, which, partly from its tenacity, and partly on account of the unnaturally widened fossæ, the patient is unable to extrude. It putrefies and produces an ozænic smell ; it dries and contracts the venous sinuses of the erectile tissue. A Vicious Circle is instituted, which, if neglected, might presumably result in true atrophy."<sup>2</sup>

Rhinitis sicca is almost invariably complicated by the presence of crusts, associated with infective processes which lead to the destruction of the mucous membrane and cause much itching. This gives rise to nose-picking with further injury to the mucosa and the development of fresh crusts (Plate X. c).

Ribary writes :

"The erosions which are associated with anterior rhinitis sicca and which frequently provoke epistaxis, may either heal or give rise to polypoid excrescences (bleeding polypus of the septum), or they may extend to the deeper parts and lead to ulceration by means of infective processes. Where healing has taken place, white, tendon-like, glistening, tongue-shaped processes of epidermis may be observed to extend from the edge of the skin on the septum into the normal mucosa. In fact as a result of the morbid process the mucous epithelium has perished, and been replaced by epidermis. The new epidermis however appears to have less resisting power than has normal cutis, since a sense of

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<sup>1</sup> *British Med. J.*, 1908, II., p. 1271.

<sup>2</sup> Allbutt and Rolleston, *System of Medicine*, IV. (ii.), p. 21 ; *Diseases of the Nose*, p. 152.

tension persists and results in renewed nose-picking and in further injury to the mucosa with its sequelæ. In this way a *circulus vitiosus* forms which perpetuates the disorder and generally lasts for the remainder of life."<sup>1</sup>

The same process often leads to a perforating ulcer, as Grünwald points out :

"I have observed several cases of this kind of perforation, and the Vicious Circle was always the same : crust formation on the septum ; picking off the crust and so causing bleeding, which led to the formation of a larger and more firmly adherent crust ; and so on, the whole process being started by some inflammatory condition, such as suppuration in the vestibule or in the interior of the nose."<sup>2</sup>

**Sinusitis.** Sinusitis has already been referred to in connection with rhinitis sicca. But there are some further circular reactions met with in this disease. Owing to the narrowness of the ducts draining the sinuses, any catarrhal congestion readily leads to obstruction, followed by retention and putrefaction of the secretions, paralysis of the cilia and further retention.<sup>3</sup> Moreover the growing irritation may steadily increase the obstruction until this becomes complete (Plate X. d).

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<sup>1</sup> *Archiv f. Laryngologie und Rhinologie*, 1896, IV., p. 314.  
Cf. also Cartaz, Castez and Barbier, *Maladies du Nez et du Larynx*, p. 34.

<sup>2</sup> Nasal Suppuration, tr. by Lamb. p. 180.

<sup>3</sup> Under the name "Vicious Circle" of the nose Ballenger describes and illustrates an area in which the ostei of the posterior ethmoidal and sphenoidal sinuses drain into the superior meatus above the middle turbinate, while the frontal, anterior ethmoidal and auxiliary sinuses drain into the middle meatus beneath the turbinates. This use of the term "Vicious Circle" is, of course, entirely distinct from that employed in this volume. *Diseases of the Nose, Throat and Ear*, pp. 118, 199, 202 f.

Kuhnt thus describes the condition as met with in the frontal sinus ; it may serve as a type of other forms of sinusitis :

“ In cases of rhinitis it is quite possible for an independent disorder to be set up in the frontal sinus, which may last long after the rhinitis has subsided. The mucous, muco-purulent or purulent secretions are either unable to escape or only do imperfectly. They are then apt to decompose, and in their turn accentuate the irritation of the mucosa. Even anatomical changes frequently result, especially in the naso-frontal duct, close the Vicious Circle, and thus prevent any probability, or even possibility, of a natural recovery.”<sup>1</sup>

Another aggravating factor may be present in purulent sinusitis, being due to the destruction of the ciliated epithelium. The aggregate effect of millions of cilia in removing the secretions, especially when working in opposition to gravity, must be of great importance. Acute inflammation, however, and especially the retention of pus rapidly destroy ciliated epithelium, and thus neutralise Nature's scavenging provisions. Retention leads to retention.

**Polypus.** The growth of a polypus seems frequently to be due to persistent irritation caused by suppuration, which is then kept up by the presence of the polypus (**Plate X. e**). The same reciprocity has been observed in other parts of the body such as the ear and the larynx.

Heymann writes :

“ The polypus irritates the adjacent structures, and thus excites, as well as maintains, a condition of inflammation. In saying this we adopt the view that a polypus may owe its origin to a condition of inflammation, so that a form of *circulus vitiosus* is established. . . . In many, probably most, cases suppuration

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<sup>1</sup> Heymann, Handbuch der Laryngologie und Rhinologie, III., p. 361.

has started and led to the formation of the polypus ; at the same time the irritation of the polypus may cause or at least keep up the suppuration. It is scarcely necessary to add that the continual bathing of the mucosa in pus may in turn give rise to fresh polypi."<sup>1</sup>

The increase in size of a polypus when once formed has been attributed to gravitation, to the kinking of the blood-vessels, to the traction caused by blowing the nose, and to a to-and-fro movement of the polypus due to respiration. It seems at any rate possible that these factors may accelerate growth, and the larger the growth, the more effectual will these factors be.

McKenzie thus refers to the action of gravity on the growth of a polypus :

"It is partly to the influence of gravity that we may attribute the liability of the lower border of the middle turbinal to polypi, for this area, hanging as it does free and unsupported over the middle meatus, will, when it becomes oedematous, sag and bag so that a bulging of certain limited portions will occur. And so polypoid excrescences will form. Further, the return circulation from these excrescences naturally becomes more and more difficult as their bulk increases. In this way a Vicious Circle is formed, and the size of a polypus is limited by the capacity of the space around it, and not by any natural tendency to stop growing."<sup>2</sup>

**Rhinolith.** The formation of concretions and calculi in the body is dependent on reciprocal reactions between the primary nucleus and the subjacent mucosa, and the same principle applies to

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<sup>1</sup> Handbuch der Laryngologie und Rhinologie, III., p. 824.

Cf. also Stoerk, Erkrankungen der Nase, des Rachens und des Kehlkopfes (Nothnagel's Pathologie und Therapie), p. 188.

<sup>2</sup> Practitioner, 1910, II., p. 186.

the rhinoliths occasionally met with (Plate X. f). The nucleus, whether consisting of a foreign body, of blood or of mucus, becomes encrusted with salts derived from the nasal secretions, and in turn acts as a source of irritation to the mucosa. The greater the irritation the more abundant the secretions and the more rapidly does the concretion grow. In some cases the nares may be completely blocked.

**Rhinitis.** Some attacks of nasal catarrh, even after recovery, greatly diminish the resistance of the nasal mucosa, a condition which shows itself by increased liability to catarrh, and each attack leaves the nose more predisposed, in fact a *locus minoris resistentiæ*. A similar condition is associated with the various nasal neuroses, and depends on the principle that a reflex disturbance once produced is so much the more easily renewed. Every attack appears to diminish the control of the nerve centres and to induce an attack on less and less provocation.

A good illustration is met with in hay fever, a paroxysmal neurosis which is especially liable to attack susceptible persons when exposed to certain kinds of pollen or effluvia. Each attack makes the individual more susceptible to the subtle influence of pollen grains, and increases the probability of fresh seizures.<sup>1</sup> In other sufferers from hay fever the idiosyncratic hyperæsthesia of the nasal mucosa seems to provoke an inflammatory hyperplasia of the affected membrane, which hyperplasia then renders the mucosa even more sensitive to the noxious agent than before. Thus cause and effect abet each other. This injurious sequence, however, is by no means constant.

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<sup>1</sup>Quain, Dictionary of Medicine, I., p. 786.



## Chapter Twelve

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### THE THROAT



ISEASES of the throat may be complicated by some circular reactions of great clinical importance.

**Diphtheria.** The throat is the favourite seat of diphtheria, a virulent disease whose tendency to extension depends on the pathological changes which take place in mucous membranes when invaded by the Klebs-Löffler bacillus (Plate XI. a). These changes vary in different cases. Sometimes a definite membrane is formed ; in other cases there is merely a delicate network of fibrin enclosing leucocytes, red corpuscles and bacteria. To these conditions are superadded stasis and exudation in the mucous membrane, portions of which may even be necrosed. These local effects of the bacilli and their toxins injure the neighbouring tissues in such a way that a favourable culture-medium is prepared for the proliferation of the bacilli and the increase of their toxins which then enter the blood. Hence it is that the morbid process tends to extend so rapidly, both superficially and in depth. Lowered resistance favours extension of the evil and *vice versa*.

**Œdema of Aryteno-Epiglottidean Folds.** In cases of congestion of the aryteno-epiglottidean folds the two œdematous swellings may be seen lying like

valves above the glottis. There is then a risk that they may be sucked together during inspiration and provoke acute dyspnœa. The greater the dyspnœa the greater the inspiratory efforts and the more closely do the œdematous folds approximate, death sometimes resulting from suffocation.

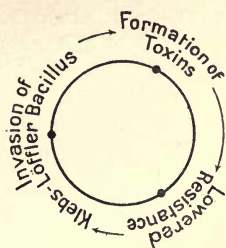
**Tongue-Swallowing.** Death may also result from tongue-swallowing, a rare accident in children whose frænum is too long or has been divided. The danger arises from the tongue being so retracted into the pharynx at the time of deglutition as to hinder the entrance of air during inspiration. The consequent dyspnœa is apt to lead to further retraction ; the tongue may even come to be fixed in the gullet like a wedge, obstructing the larynx so completely that no air can reach the lungs. Several cases of asphyxia due to this condition are on record.<sup>1</sup>

**Laryngitis.** Laryngitis is frequently a self-perpetuating condition through its effects reacting on their cause. For example, congestion and erosion of the cords provoke severe paroxysms of coughing. The inflamed surfaces are brought into violent contact, and this in turn aggravates the mischief.

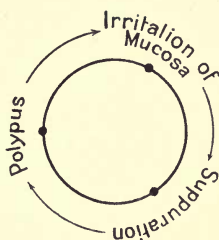
The accumulation of adhesive secretions is another source of irritation, which is accentuated by the constant efforts that are made to clear the throat. The secretions also interfere with the repair of an inflamed mucosa or of an ulcer, an injurious reciprocation being maintained in all these ways. Even hoarseness does harm by the increased effort involved in the act of speaking or singing. The greater the effort the more does the laryngeal congestion increase.

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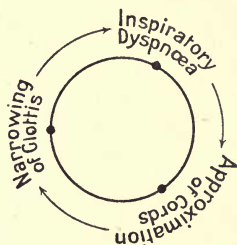
<sup>1</sup> An illustration shewing how readily such asphyxia may be brought about is given by Hare, *Practical Therapeutics*, p. 670.



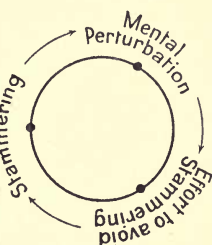
(a) DIPHTHERIA



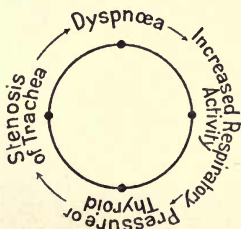
(b) POLYPUS



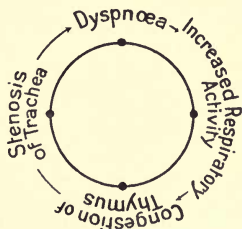
(c) ABDUCTOR PARALYSIS



(d) STAMMERING



(e) GOITRE



(f) ENLARGED THYMUS

Plate XI.—Circles associated with the Throat.

Injurious correlations also occur in tubercular laryngitis owing to the associated cough, vomiting and dysphagia. In consequence of the irritability of the larynx the cough may be incessant, and rob the sufferer of the sleep and laryngeal rest which are so essential if the progress of the disease is to be checked. The cough may also be accompanied by frequent vomiting so that an insufficient amount of food is retained. The resulting malnutrition diminishes the power of resistance and accelerates the disease. Again when the epiglottis is invaded by tubercular deposits there is often acute pain on deglutition, and the suffering and dysphagia may cause the refusal of all food, however appetising. The victim is in as grievous a predicament as Tantalus of old ; emaciation and aggravation inevitably result.

In patients in whom there is an exaggerated reflex susceptibility of the nervous system, excessive cough may so irritate and exhaust the medullary centre as to pervert the reflex mechanism. The cough becomes uncontrollable and persists even though all local irritation has subsided.

Chronic laryngitis is frequently associated with the formation of neoplasms, each disorder favouring the other. The sequence of events is much the same as those occurring in the nose and the ear (**Plate XI. b**). Sometimes a pedunculated growth may be sucked into the glottis so as to provoke urgent dyspnoea, followed by increased impaction and death.

Schrötter writes :

“Chronic catarrh is very frequently associated with new growths in the larynx, a Vicious Circle being clearly present. The catarrh leads to the formation of the neoplasm and this, especially if pedunculated, keeps up the catarrh.”<sup>1</sup>

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<sup>1</sup> Vorlesungen über die Krankheiten des Kehlkopfes, p. 66.

Chronic laryngitis presents an illustration of that condition in which primary disease leaves behind it a diminished resistance to fresh attack, a liability to recrudescence on the slightest exposure. There is no permanent *restitutio ad integrum*, and each attack may end in an increase of mischief.

**Laryngismus Stridulus.** According to various writers the respiratory glottic spasm of laryngismus stridulus may be a self-perpetuating condition owing to the increasing venosity of the blood due to the spasms.

The spasms are supposed to cause venosity, which venosity induces fresh spasms which occasionally prove fatal.

This view was held by Charles West :

“When once convulsions have occurred, a new element soon comes into play, which aggravates the danger and increases the frequency of an attack. The blood, imperfectly depurated, if the disturbance of respiration has been considerable, seems in itself to exercise an injurious influence, by increasing the irritability of the nervous system and thus promoting the return of the attack. If once convulsions have occurred, the probability of their recurrence is much increased ; and the oftener they have happened, the more often are they likely to return, and the graver is the prognosis which you are compelled to form. This rule holds good, too, not only with reference merely to spasmodic croup, but with reference to all spasmodic affections of the respiratory organs, and whooping cough affords one of its best exemplifications. In some fit of coughing more violent than any of the others, the spasm of the larynx is of longer continuance, the face grows livid, a fruitless expiratory effort is made, and before the spasm relaxes a convulsion takes place. This convulsion is but very seldom a solitary one. You notice that for hours it is succeeded by very accelerated breathing ; by which, however, the blood is very imperfectly depurated, as you see by the lips which never resume their natural colour. At length



the disturbance once more reaches its climax, and another, and then another convulsion occurs, with a gradually-diminishing interval, until death takes place."<sup>1</sup>

Hughlings Jackson held similar views :

"Great venosity of the blood will much over-stimulate the naturally very excitable respiratory centres in infants,<sup>2</sup> and thus produce respiratory convulsions. When there has been first set up any degree of spasm of any part of the respiratory apparatus, the venosity will become greater still, and thus there will be a rapid multiplication of effects. In other words a Vicious Circle is established. Super-venosity initiates the paroxysm, which increases the super-venosity."<sup>2</sup>

This theory is, however, by no means generally accepted. In many cases the increased venosity seems to arrest rather than prolong the convulsions.

Another form of spasmodic closure of the larynx is sometimes observed in cases of reflex rigidity caused by a surgical operation. This may also be a self-perpetuating condition, as Mortimer points out :

"Reflex rigidity from surgical proceedings is accompanied by more or less spasmodic closure of the larynx and retraction of the tongue, and efforts must be made to maintain a free air-way by such means as pushing forward the tongue, and introducing a tube between the tongue and palate. Non-aëration increases rigidity, the extraordinary respiratory muscles being called into action, so that a Vicious Circle is formed."<sup>3</sup>

**Paralysis of the Abductors.** A deadly vortex may be set up in connection with paralysis of the abductors, i.e. the posterior crico-arytenoid muscles (Plate XI. c). In normal respiration the glottis

<sup>1</sup> *Medical Times*, XIX., p. 522.

<sup>2</sup> *Brain*, IX., pp. 14, 15 ; XII., p. 491.

<sup>3</sup> *St. Bartholomew's Hospital J.*, 1917, I., p. 89.

dilates with every inspiration, and the deeper the inspiration the wider the glottis. When, however, the abductors are paralysed, inspiration is no longer assisted by dilatation of the glottis, but, on the contrary, is impeded by increased approximation of the cords, which are separated by a mere chink. The narrowing of the glottis provokes dyspnœa and the dyspnœa leads to further narrowing. A sufferer from bilateral posticus paralysis has a sword of Damocles hanging over him.

**Stammering.** Exaggerated self-consciousness and stammering are frequently correlated (Plate XI. d). Many persons stammer but slightly when perfectly at ease. But any mental perturbation at once aggravates their disability, and this aggravation in turn intensifies their perturbation. The stutterer stutters most when he is trying hardest to avoid stuttering.

Another neurosis is associated with the globus hystericus, the sensation of a lump that rises in the throat and is probably due to pharyngeal spasm. The disorder is one that occurs in sensitive introspective persons and in its turn excites auto-suggestions.

**Tracheal Stenosis.** Dangerous correlations may occur in cases of enlarged thyroid, where this gland compresses the trachea and reduces the lumen to a slit; acute and sometimes fatal attacks of dyspnœa are liable to come on quite unexpectedly (Plate XI. e). Started, perhaps, by some casual effort, the dyspnœa calls the supplementary respiratory muscles (especially the sterno-hyoids and -thyroids) into action. These in contracting press the hypertrophied thyroid against the trachea, further diminish the lumen and so increase the dyspnœa. Thus the victim is caught in a dangerous sequence, and unless skilled help is promptly given, dies miserably self-garotted. The

very mechanism devised for increasing the supply of air through the narrowed trachea aggravates the stenosis.

Fränkel writes :

“The sufferer gets into the clutches of a Vicious Circle. The greater the want of oxygen, the more vigorous and prolonged the muscular contractions ; the more vigorous the latter, the greater the compression of the trachea and the less room for the admission of air.”<sup>1</sup>

A goitre is also liable to press on or stretch nerves which reflexly produce respiratory spasm ; this then leads to further pressure.

Again the heightened blood-pressure produced during expiration raises the pressure in the extensive plexus of veins that encircle the thyroid gland. In this way increased swelling of the goitre is brought about, and the stenosis is aggravated. Venous hæmorrhage into adenomatous cysts may also set up morbid correlations. The increased pressure on the trachea leads to dyspnœa, to over-filling of the right heart, and to congestion of the veins of the neck. This congestion in turn aggravates the hæmorrhage.

Similar complications follow, when, instead of the trachea being compressed from without, there is endotracheal stenosis, due to syphilis or a new growth. The stenosis brings on dyspnœa and increased activity of the respiratory muscles. This causes an overfilling of the right side of the heart during inspiration owing to the increased suction action. During expiration, on the other hand, the high intra-thoracic pressure exerted on the lungs hinders the entry of the blood into the lungs, and the effect of this is further to increase dyspnœa.

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<sup>1</sup> *Lungenkrankheiten*, p. 8. Cf. also Jacobson and Rowlands, *Operations of Surgery*, I., p. 610.

Fränkel writes :

"Any condition which accelerates the venous flow on the right side of the heart must under such circumstances aggravate the state of the patient. This applies especially to increased muscular activity, and to the increased dyspnœa necessarily associated with it. A *circulus vitiosus* is thus established as a result of the increased respiratory activity."<sup>1</sup>

**Enlarged Thymus.** A fatal process of reciprocation is occasionally associated with thymic enlargement, owing to the readiness with which any hyperplasia of the gland causes pressure on the trachea and dyspnœa (Plate XI. f).

The normal thymus weighs about 6 grms., but in cases of lymphatism the weight may rise to 50 grms. or even more. In early life the interval between the manubrium and the spinal column only measures 2.5–3 cm., so that even a moderate hyperplasia may produce tracheal stenosis and consequent dyspnœa. Such dyspnœa in turn leads to venous engorgement and further enlargement of the thymus, thus setting up a "Vicious Circle that may quickly lead to suffocation."<sup>2</sup>

**Mutism.** In cases of shock, such as that due to the high explosives used in modern warfare, various nervous disorders have been met with due to a suspension of the connection between the peripheral impulses and the higher cortical centres of the nervous system. The victim may be so convinced that he is mute that he actually becomes so through auto-suggestion, and makes no attempt to speak. Suggestion sometimes succeeds in switching on the interrupted synapses between the vocal organs and the cerebral cortex and thereby restores the power of speech. Parallel conditions have been described in connection with vision and hearing.

<sup>1</sup> Lungenkrankheiten, p. 29.

<sup>2</sup> Osler and Macrae, System of Medicine, IV., p. 926.

## Chapter Thirteen

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### THE EAR



FOR the purpose of description the ear is divided into three parts: external, middle and internal. Injurious circular reactions associated with the ear may be arranged in the same divisions.

#### I. THE EXTERNAL EAR

The external ear is liable to various inflammatory conditions which may be self-perpetuating.

**Otitis Externa.** Simple otitis externa gives rise to unhealthy secretions which if allowed to stagnate in the meatus set up irritation and congestion, which excite further secretion and accumulation. This complication is especially common if the canal is narrowed, since the tendency to retention is thus increased.

In some inflammatory conditions mycotic infection may be present, due to the spores and mycelium of the *aspergillus niger* or other fungus. The parasite nourished by the secretions penetrates beneath the epidermis and excites further inflammation. Indeed the disease largely depends on the fact that the fungus increases the discharge and thus promotes its own growth.

The skin of the meatus may also be the seat of an infective disorder, when one or more hair-follicles



are invaded by staphylococci. The invasion is generally accompanied by itching, which leads to scratching, abrasion and fresh inoculation. The succession of boils so often observed is usually due to auto-inoculation caused by scratching.

Another common inflammatory disorder is eczema which is frequently complicated by pruritus. This pruritus leads to scratching which perpetuates the trouble.

Guisez writes :

“Eczema of the meatus is always associated with very severe itching, which obliges the sufferer to scratch. The resulting abrasions perpetuate the inflammation of the epidermis and thus prevent recovery.”<sup>1</sup>

The formation of crusts also tends to prolong the disease by retaining secretions which are liable to become infected. Such infection aggravates the irritation and inflammation of the subjacent tissues.

**Accumulation of Cerumen.** Occasionally persons are met with who suffer from an excessive secretion of cerumen due to hyperæmia of the lining membrane (**Plate XII. a**). A laminated epithelial plug may thus be formed composed of the horny layer of the cutis of the auditory canal. Such a plug if allowed to remain *in situ* excites further irritation and hyperæmia, and stimulates the glands to abnormal activity.

## II. THE MIDDLE EAR

**Otitis Media.** A serious self-perpetuating condition arises when, as a result of Eustachian obstruction, inflammatory discharges are pent up in the tympanum and undergo putrefaction, forming indeed a septic tank. Such discharges irritate the mucous lining of the cavity and excite further discharge which aggravates the disease (**Plate XII. b**).

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<sup>1</sup> La Pratique Oto-Rhino-Laryngologique, III., p. 83.

Again the accumulation of inflammatory products in the tympanum exerts pressure on the superficial veins and lymphatics and blocks the natural channels of absorption. Such closure leads to increased accumulation and increased pressure.

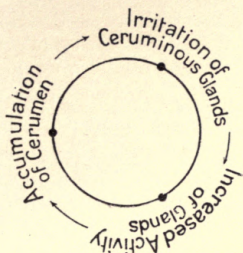
The destruction of ciliated epithelium by pus is another source of injurious correlations. During health the movements of the cilia are directed towards the pharynx and assist in clearing the tympanum of epithelial or other detritus. Retained pus, however, destroys this epithelium and abolishes the scavenging mechanism. Retention leads to retention.

A similar sequence may involve the accessory cavities of the tympanum, viz. the antrum and mastoid cells. Indeed the conformation of the temporal bone, with its warm and moist cavities and the awkwardly situated efferent ducts, greatly favours the imprisonment and putrefaction of inflammatory and other *débris*, the narrow communicating channels being readily obstructed and blocked.

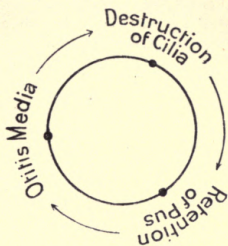
Chronic catarrhal otitis associated with Eustachian obstruction is often complicated by rarefaction of the air in the tympanic cavity due to a process of absorption. The result is that the drum membrane is gradually stretched and eventually comes to lie against the internal wall of the tympanum, thus maintaining the otitis.

Dench writes :

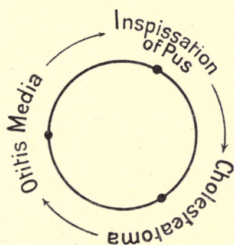
“ A gradual stretching of the drum membrane takes place from the continued pressure from without, until finally further displacement is prevented by contact with the internal tympanic wall. The pressure against this resisting barrier increases the local inflammatory process. The movement of the drum membrane inward and its persistence in this position is favoured by the action of the tensor tympani muscle, which by contraction draws the



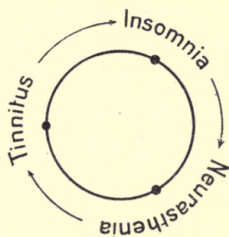
(a) ACCUMULATION OF CERUMEN



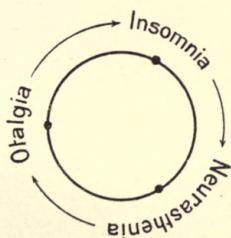
(b) OTITIS MEDIA



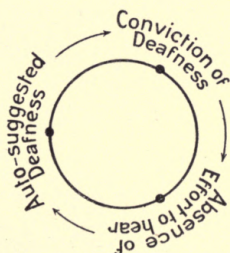
(c) CHOLESTEATOMA



(d) TINNITUS



(e) OTALGIA



(f) AUTO-SUGGESTED DEAFNESS

Plate XII.—Circles associated with the Ear.

membrane inward against the wall of the middle ear. From disuse the tendon becomes shortened, this change being aided by the inflammatory process."<sup>1</sup>

An occasional consequence of purulent otitis media is the formation of a cholesteatoma, consisting of inspissated pus mixed with exfoliated epithelial cells (**Plate XII. c**). The constant friction of this mass irritates the enclosing walls and provokes a continual proliferation and desquamation of cells, which in turn become adherent to the mass and so add layer to layer. The cholesteatoma thus increases much as does a vesical or a biliary calculus, irritation leading to growth and growth to increased irritation. The mass may in time reach the size of a walnut, and produce grave or even fatal results by invading the labyrinth or cranial cavity.<sup>2</sup>

**Polypus.** Aural polypus may be associated with similar morbid correlations to those observed in connection with the nose. In some cases at any rate an aural polypus appears to result from, as well as to perpetuate, suppuration.

Gradle writes :

"Well-ascertained histories often teach that polypi are started by prior suppurative disease, which their presence then serves to perpetuate."<sup>3</sup>

**Deafness.** Deafness may itself tend to further deafness by preventing the accurate adjustment of the tensor tympani to the vibrations of sound that reach the drum, and thus making it difficult to give the attention necessary for good hearing.

<sup>1</sup> Diseases of the Ear, pp. 310, 360.

<sup>2</sup> Denker and Brünings, Krankheiten des Ohres und der Luftwege, p. 125.

<sup>3</sup> Diseases of the Nose, Pharynx and Ear, p. 1910. This quotation applies to the ear as much as to the nose.

Urbantschitsch writes :

“Impaired hearing is aggravated by inadequate auditory stimulation, by inattention as well as by inability to participate in social life. Hence a paralyzing isolation envelops the hard-hearing person more and more closely. Systematic auditory exercises are obviously of great importance.”<sup>1</sup>

Deafness may also be aggravated when persons suffering from relaxation of the drum and associated disorders of the ossicles and labyrinthine window endeavour to improve their hearing by continually inflating the tympanum. Some sufferers use the Valsalvan method of inflation, others blow their nose in order to force air into the Eustachian tube. Although there may be a temporary improvement as a result of this manœuvre, its constant repetition leads to further stretching of the membrane, the loose folds of which come to rest on the inner tympanic wall and incudo-stapedial articulation. The deafness is thus permanently increased through the operation of an artificial Circle.

Heath writes :

“The constant distension of the tympanum with air must increase the relaxation of the weakened tympanic structures, and this allows of a further unopposed muscular stretching of the labyrinthine window, thus aggravating the condition which is the essential cause of the deafness.”<sup>2</sup>

After an attack of otitis media the middle ear often remains a *locus minoris resistentiæ*. The incompleteness of recovery is shown by a disposition to relapse, by a diminished resistance to fresh disease, and with every attack the permanent

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<sup>1</sup> *Deutsche Klinik*, VIII., p. 274.

<sup>2</sup> The Treatment of Deafness (*Paracusis Willissii*), p. 64. Cf. also Politzer, *Diseases of the Ear*, pp. 142, 198, 342.



lesion increases until the cumulative mischief may be very extensive.

An allied condition may be met with when serious and debilitating illness has greatly lowered the resistance of the organism to pathogenic influences. During health a great variety of micro-organisms are present in the normal mucosa of the tympanum without causing any symptoms. If, however, prolonged pyrexia or other drain on the system lowers resistance and renders the tissues more vulnerable, the pathogenic microbes may become active and virulent. For example, a suppurating ear may produce a lowered state of health ; such ill health will keep up the suppuration which would cease under more favourable bodily conditions. The local and general disorders perpetuate each other.

### III. THE INTERNAL EAR

**Neuroses.** In neuropaths severe tinnitus may be both cause and effect of neurasthenia. Acute torment may be caused, and the more the mind is concentrated on the disorder the more is the sufferer harassed. Even men of strong nervous temperament have been so grievously obsessed by noises in the head as occasionally to commit suicide. A somewhat similar condition arises, when the persistent otalgia that complicates some forms of aural disease induces hyperæsthesia and neurasthenia, especially if insomnia is superadded (**Plate XII.** d, e).

Even apart from tinnitus and otalgia, any impairment of hearing power is likely to react unfavourably on neurasthenia, owing to the continued aural strain involved in the effort to hear. Such strain is a constant tax on the reserves of nervous energy. In the morning, when refreshed by a night's rest, the patient hears fairly well. But as the day passes the

nervous system becomes over-taxed and he loses the power of concentrating attention. This involves increased deafness and increased auditory strain.

Dench writes :

“ After being subjected to the fatigue consequent on the day's activity, the hearing power becomes much diminished, and any effort on the part of the patient to disguise the symptom simply magnifies it. The local impairment, in turn, reacts upon the general condition of the patient to a considerable degree, frequently causing him to become hypochondriac, and in some cases leading to acute melancholia.”<sup>1</sup>

Many forms of deafness seem to impair vitality, doubtless owing to the fewer stimuli that reach the sensorium. This is frequently observed in early life. Deaf children lack vitality and such lessened vitality increases their deafness.

**Auto-Suggestion.** Another form of deafness is due to auto-suggestion. For example, after the explosion of a shell a soldier may be convinced that he is deaf and make no attempt to listen (**Plate XII. f**). The aural perceptive structures in the brain may be dissociated from the nervous tracts which convey the peripheral stimuli from the ears, so that sound vibrations fail to produce the slightest auditory sensations. Suggestion frequently succeeds in restoring the hearing by re-association, by switching on the interrupted synapses.

Hurst writes :

“ The momentary deafness, which is the natural result of the terrific noise caused by the explosion of a big shell in the immediate neighbourhood, may make such an impression on the mind of a soldier that, on coming to himself, whether he has actually lost consciousness or not, his first thought is for his hearing, especially if it was already impaired by preceding

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<sup>1</sup> Diseases of the Ear, p. 663.

disease, and he may be so convinced that he is permanently deafened that he becomes actually deaf as a result of auto-suggestion. Hearing necessitates listening. Inattention during a dull sermon results in total deafness to the sermon, and in hysterical deafness the patient is so convinced that he cannot hear that he does not listen ; although the sound vibrations reach the ear in the normal way, they do not give rise to the slightest auditory sensation because of this inattention. The synapses at one or more of the cell-stations in the auditory path to the cerebral cortex must therefore be unswitched, probably as a result of retraction of the dendrons."<sup>1</sup>

**Vertigo.** Vertigo is another aural neurosis which reacts on the primary disorder and so perpetuates its own cause. The victim may lose confidence in himself and becomes the prey of phobias which feed the neurosis.

Bing writes :

" If a neurasthenic has once experienced a subjective difficulty of this sort the fear of vertigo makes itself felt in a very marked form and the recurrence of such symptoms naturally increases this fear—a painful Vicious Circle. Fortunately in very few cases does an actual permanent vertigo appear."<sup>2</sup>

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<sup>1</sup> *Proc. Royal S. of Med.* (1917), X. (iii.), (*Otology*), p. 115.

<sup>2</sup> *Nervous Diseases*, p. 412.

# Chapter Fourteen

## THE SKIN



THE following classification of disorders of the skin will be found convenient :

- I. Inflammatory Disorders
- II. Parasitic Disorders
- III. Disorders associated with Appendages of the Skin—Hair, Nails, Sweat and Sebaceous Glands
- IV. Neuroses

### I. INFLAMMATORY DISORDERS

**Eczema.** Eczema will serve as a type of various disorders which are self-perpetuating through the pruritus which they excite (Plate XIII. a). The itching and associated scratching aggravate, and may indefinitely prolong, the lesion that produced them.

McCall Anderson, speaking of acute eczema, says :

“Scratching always aggravates the disease and tends to bring out fresh crops of eruption. . . . Often in mild cases, where there is not much infiltration, the disease is kept up by the scratching alone.”<sup>1</sup>

Similar correlations occur in chronic eczema, as Kaposi points out :

“The attendant itching is generally very severe and induces violent scratching. This acts as a cutaneous irritant and may excite a fresh eczema.”<sup>2</sup>

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<sup>1</sup>Diseases of the Skin, p. 103.

<sup>2</sup>Diseases of the Skin, p. 345.

When scratching has been indulged in over a long period, the skin may undergo a process known as lichenification, characterised by the presence of pseudo-papules and accompanied by furious itching due to irritation of the nerve endings by the dermatitis.

Malcolm Morris writes :

“The itching provokes scratching, the scratching sets up lichenification which irritates the nerve endings and provokes further itching. The main object of treatment is to break this Vicious Circle by reducing the lichenification and restoring the damaged tissues to the normal state.”<sup>1</sup>

Chronic eczema is often associated with varicose veins and ulcers of the leg. The varices give rise to itching and scratching, as a result of which papules, excoriations, hæmorrhages and crusts are produced. The consequent inflammation and itching lead to deeper excoriations and increased inflammation. Eventually the skin breaks down, giving rise to the well-known varicose ulcer.

Kaposi writes :

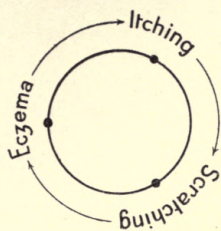
“These secondary inflammatory processes aggravate, for the time, the local exudation and congestion and are themselves, again, causes, leading to the destruction of the scarcely reproduced young tissue, that is, of the granulations and cicatrices. They are, therefore, a source of ulceration, at the same time that originally they resulted from it. . . . Such a condition of the skin predisposes in a high degree, *per se*, to renewed attacks of inflammation on the slightest provocation ; and, since the inflammation again tends to maintain and increase the ulceration, we have here an endless *circulus vitiosus*.”<sup>2</sup>

Varicose ulcers may also be complicated by what Unna terms an “incurable *circulus vitiosus*” due to

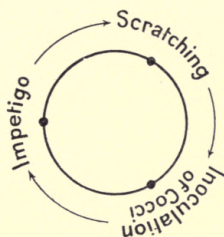
<sup>1</sup> *British Med. J.*, 1912, I., p. 1472. Cf. also Mraček, *Handbuch der Hautkrankheiten*, II., p. 300.

<sup>2</sup> Hebra, *Diseases of the Skin*, V., p. 25.

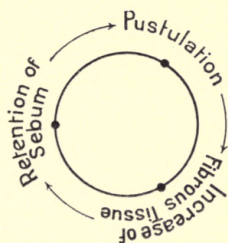




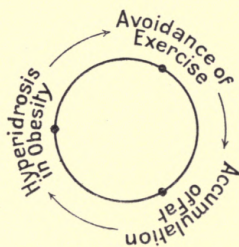
(a) ECZEMA



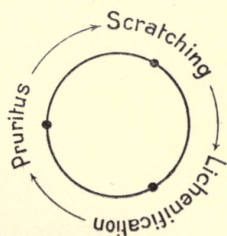
(b) IMPETIGO



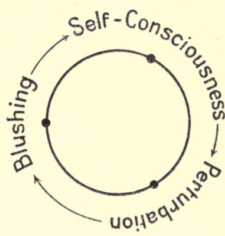
(c) ACNE



(d) HYPERHIDROSIS



(e) PRURITUS



(f) BLUSHING

Plate XIII.—Circles associated with the Skin.

a disappearance of elastin caused by a chronic œdema.

Unna writes :

“Owing to the loss of elastin, the œdematous skin gradually loses more and more elasticity ; that is, the spontaneous elastic recoil of the collagenous tissue, displaced by pressure or by movements of the body, takes place more and more slowly and incompletely ; the muscles of the skin lose a great part of their action on the skin texture. Thus we have an additional factor, favouring the œdematous swelling of the cutis. By the œdema directly attacking the elastin it interferes with the most important factor in the healing of œdema and induces an incurable *circulus vitiosus*, which terminates in complete loss of resistance of the skin, rupture of the epidermis, and lymphorrhœa externa.”<sup>1</sup>

Eczema may also provoke reverberations in distant regions of the body which react on the primary disorder. Such reverberations are not uncommonly observed in elderly persons whose depressed vitality may have favoured the dermatitis, while this is in turn aggravated by its effects.

Insomnia due to persistent irritation is not an uncommon intermediary. In other cases the digestive system appears to be affected by the cutaneous eruption and *vice versa*.

Malcolm Morris writes :

“The irritation of the skin may . . . set up reflex irritation in the intestine, preventing the proper digestion of food. The irregularity of the bowels reacts in turn on the skin, and thus a Vicious Circle is established.”<sup>2</sup>

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<sup>1</sup> Histopathology of Diseases of the Skin, p. 40. Cf. also Koch, *Archiv f. Dermatologie und Syphilis*, XXXIV., p. 228.

<sup>2</sup> Diseases of the Skin, p. 276. Cf. also Kaposi, *l.c.*, pp. 918-922 (quoted in *British J. of Dermatology*, 1901, XIII., p. 37.)

**Intertrigo.** Morbid correlations may also complicate intertrigo, a dermatitis which is liable to occur when opposing surfaces of the skin remain long in contact and exposed to the natural heat and moisture of the body. The superficial epithelium is then apt to desquamate, leaving the deeper layers of the skin exposed to the air. From these denuded surfaces free exudations take place which tend to undergo decomposition and to set up further irritation and further exudation. Cause and effect react on each other.

Examples of such intertrigo are often seen in young children whose ears are covered and pressed to the sides of the head by a tight fitting cap or bonnet, this head-dress amongst the poor being often worn for days together. The posterior aspect of the auricle and the adjacent integument of the head are then often attacked by intertrigo.

Hyde writes :

“In such localities the disorder, beginning as an erythema traumaticum, proceeds by its irritative effects to stimulate the secretion of sweat, which is freely poured out between the adjacent folds of skin, and may there temporarily be imprisoned. The surface, heated and reddened, is also somewhat macerated by the effused perspiration, and the latter, when chemically altered, as it is frequently under these circumstances, adds still further to the original disorder.”<sup>1</sup>

**Urticaria.** Urticaria is another form of dermatitis which is accompanied by severe itching and burning, which compel the patient to scratch furiously in order to obtain relief. The scratching, whilst affording a sense of satisfaction, only too often provokes a fresh crop of wheals.

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<sup>1</sup> Diseases of the Skin, p. 143.

Gaucher writes :

“The wheals are accompanied by intense itching, which causes the sufferer to scratch himself. This scratching gives rise to a further crop of wheals.”<sup>1</sup>

A very similar process occurs in lichen ruber.<sup>2</sup>

**Clavus.** A corn is primarily a protective hyperkeratosis caused by intermittent pressure, and occurs in situations where the skin is most liable to pressure, such as the plantar region. In the centre of the thickened horny layer a conical plug or core usually forms and this by pressing on the underlying sensitive corium sets up irritation and stimulates the papillæ to rapid proliferation. The more the papillæ are irritated the more rapidly they grow, and the more they grow the more is the corn raised above the surface and therefore exposed to pressure.

Ellis writes :

“The relation between corns and too tight or badly fitting boots is too obvious for dispute. Corns are illustrations of the law that intermittent pressure and friction cause over-growth. The cuticle becomes thickened at the pressure point until, in turn, it becomes itself a cause of pressure from its own hardness and large size. Here removal of the cause is speedily followed by disappearance of the effect.”<sup>3</sup>

Callosities are also due to hypertrophy of the horny layer and are often complicated by inflammation of the underlying corium, cause and effect reacting on each other. A similar reciprocation is present in the case of bunions.<sup>4</sup>

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<sup>1</sup>Maladies de la Peau, p. 60.

<sup>2</sup>Gaucher, *l.c.*, p. 133.

<sup>3</sup>The Human Foot, p. 89.

<sup>4</sup>Ellis, *l.c.*, p. 86.

## II. PARASITIC DISORDERS

### (a) Animal Parasites

**Oxyurides.** A familiar illustration of reciprocal correlations due to an animal parasite is met with in the case of oxyurides. The irritation at the anus and the consequent scratching lead to portions of the helminths or to their eggs being caught under the finger-nails, conveyed to the mouth and swallowed. From the stomach the ova pass into the intestines and rapidly attain sexual maturity. In this way the irritation ensures, by auto-infection, successive generations of the parasite.

**Scabies.** Scabies may also be perpetuated through the itching and scratching excited by the acari. The parasite may lodge under the finger-nails, and thus be transferred from one part of the body to another.

**Pediculosis.** Similar correlations may be associated with pediculi capitis. The crawling and sucking of the lice cause itching, the itching provokes scratching of the infected area, the scratching transfers the lazy louse to fresh pastures. Moreover the finger-nails often produce excoriations and exudations, and thus supply further food material for the lice and accelerate their propagation. The louse itself secures its own nutriment, for when it has satisfied its appetite and withdrawn its haustellum, a drop of blood wells up to the surface, thus supplying further food.

Again the inflammation and tenderness of the skin associated with pediculosis prevent the proper use of the brush and comb. The diseased spot and its infesting colony are left undisturbed so that the lice can multiply at their leisure. Moreover the cutaneous exudations readily form crusts and glue



the hairs together, thus affording a hiding-place for the increase of the parasites. Especially is this the case in those countries where the *plica polonica* is still in fashion ; no wonder that, in Hebra's words, "the lice swarm as if one had disturbed a nest of ants."

Some writers believe that severe deprivation and exhaustion such as occur during war greatly favour the extension of lousiness, while this condition tends to further debility. This sequence of events was often observed during the Crimean war, and was doubtless dependent on the severe hardships endured by the troops.

Longmore writes :

"The lice multiplied with marvellous rapidity in the clothes and persons of men who became anæmiated and much debilitated, and the increase of vermin, and increase of debility, by mutual co-action, went on at least at geometrical ratio, until death carried off the man."<sup>1</sup>

### (b) Vegetable Parasites

These may be subdivided into :

(i.) Fungi

(ii.) Bacteria

(i.) Fungi

**Ringworm.** Some important reciprocations are established when ringworm invades the hairy or the glabrous regions of the skin. For example, if an endothrix member of the trichophytons insinuates itself between the cuticle cells of the hair, it rapidly proliferates, so that the shaft becomes stuffed with spores, grows brittle and readily splits or breaks off. The detached portion laden with spores is then free to spread infection far and wide ; in fact the

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<sup>1</sup> *British Med. J.*, 1914, II., p. 679.

continual breaking off of the hair is the chief means by which the spores of the parasite are dispersed. The fragment of hair remaining in the follicle may also perpetuate the infection.

Another complication occurs when ringworm provokes itching and scratching, and so leads to the auto-inoculation of fresh foci. The parasite is apt to lodge under the nails and to be transferred to another portion of the scalp ; or the nail itself may be invaded by onychomycosis, which facilitates the inoculation of fresh areas. The ordinary combing and cleansing of the hair also assists in diffusing infection, and this leads to further cleansing. Especially injurious is the washing of the hair, since water nourishes the fungus.

Sabouraud writes :

"Any attempt to cleanse the diseased scalp disperses the infective agent and creates fresh points of inoculation. In girls, for instance, the linear tracts left by the use of the comb are indicated by rows of diseased hairs."<sup>1</sup>

When the fungus infects the non-hairy skin, it causes dissociation of the epidermic cells, and the *débris* supplies the parasite with the sustenance necessary for its further growth. The irritation also provokes inflammation and exudation, both of which are favourable to rapid multiplication.

Similar correlations are established in the case of favus and tinea versicolor. The fungus may provoke inflammatory reactions, as shown by discomfort, burning or itching. The consequent rubbing or scratching may then transfer the fungus to fresh areas, where the infection is reproduced.

In some regions of the body fungus infection is especially prone to provoke hypersecretion which supplies further nutriment and thus favours parasitic

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<sup>1</sup> Pratique Dermatologique, IV., p. 480.

growth and extension. A good example of this is presented by otomycosis due to some form of aspergillus or other fungus. Both the ceruminous and sebaceous glands of the external auditory meatus may be stimulated by activity of the parasite which penetrates into the lining membrane. Even obstruction of the meatus with retention of secretions is occasionally brought about.

### (ii.) Bacteria

**Impetigo.** Impetigo contagiosa may be taken as an example of a dermatitis due to bacterial infection. The eruption gives rise to discomfort and itching; the itching leads to scratching. The finger-nails become infected by the sero-pus containing the streptococci, which then are readily inoculated into any excoriations produced by the scratching (**Plate XIII. b**). Indeed repeated auto-inoculations may cause an indefinite persistence of the disease.

Sequeira writes :

“The eruption itches, and auto-inoculation is exceedingly common. By scratching and simple contact fresh spots form with great rapidity, and large areas may be involved.”<sup>1</sup>

Ecthyma, furunculosis and sycosis may be perpetuated by a similar mechanism.

## III. DISORDERS ASSOCIATED WITH APPENDAGES OF THE SKIN—HAIR, NAILS, SEBACEOUS AND SWEAT GLANDS.

### (a) The Hair

Several circular reactions associated with the hair (e.g. pediculosis, ringworm etc.) have been already alluded to. There remain others which must now be dealt with.

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<sup>1</sup>Diseases of the Skin, p. 149.

**Baldness.** According to some writers baldness may be dependent on reciprocally acting factors. Owing to the fashion of keeping the head covered and of thus depriving the hair of sun, air and nourishment (especially if a hard-rimmed, tight hat is worn) the hair in the regions most frequently covered tends to atrophy and fall out. The result is more or less extensive baldness, which in its turn necessitates increased use of the head gear.

Brocq writes :

“Persons who keep their heads constantly covered with a heavy and tightly fitting hat lose their hair much more rapidly than those who keep their head uncovered.”<sup>1</sup>

**Hirsuties.** The opposite condition, viz. hirsuties, is often associated with an artefact owing to the practice of epilation or to the application of depilatories. Neither of these methods of getting rid of hair possesses any permanent value ; they merely make new hair grow more luxuriantly than before by increasing the local circulation and provoking hypertrophy of the papillæ. The hypertrichosis leads to epilation and this to further hypertrichosis. It must, however, be added that the causation both of baldness and hirsuties is still *sub judice*. The sequence of events suggested above is by no means universally accepted ; doubtless the ætiological factors vary in different cases.

### (b) The Nails

The nails have more than once been mentioned as agents in the perpetuation of disease. At times they aggravate the pruriginous disorders they are intended to relieve, as in the case of eczema and urticaria. At other times, when used to relieve pruritus, they become the carriers of infection, as in the case of oxyurides or impetigo.

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<sup>1</sup>Pratique Dermatologique, I., pp. 318, 375.

**Onychogryphosis.** The nails themselves are sometimes diseased. Thus Heller has drawn attention to a process of reciprocation that is established in onychogryphosis, owing to a keratoma in the nail bed :

“ This cushion-like growth, caused by the inflammatory irritation in the matrix, raises up the nail-plate and disturbs its natural growth. This raising of the nail also increases the angle between the matrix and the nail-plate, as this latter emerges from the posterior fold. A *circulus vitiosus* is now established, since the space between the plate and the matrix (owing to the plate being obliquely raised) again becomes filled by the horny growth.”<sup>1</sup>

**Ingrowing Toe-Nail.** A somewhat similar process may complicate onychia, where inflammation leads to accelerated growth, and this in turn intensifies the inflammation. This condition occurs with ingrowing toe-nail, as Sir Jonathan Hutchinson points out :

“ As soon as any degree of inflammation has been set up, the conditions aggravate each other ; the inflamed nail expands and grows laterally against the raw surface, now unable to tolerate any pressure. No doubt, also, as in onychia maligna, the secretion produced is in itself a source of irritation.”<sup>2</sup>

### (c) The Sebaceous Glands

**Sebaceous Cysts.** Various skin disorders are due to obstruction of efferent ducts and the consequent accumulation of retained secretions. For example, hyperkeratosis of the outer third or funnel of a pilo-sebaceous follicle may give rise to a comedo plug, whose presence acts as an irritant and promotes further hyperkeratosis. Sebaceous cysts often

<sup>1</sup> Mraček, Handbuch der Hautkrankheiten, IV. (ii.), p. 569.

<sup>2</sup> Lectures on Clinical Surgery, I. (i.), p. 144.



arise by a similar process, the accumulation of sebaceous matter causing hyperactivity of the follicular walls and increased accumulation. The same may be said of acne vulgaris, where inflammation of the walls of the follicles is probably associated with microbic infection. The increased secretion leads to increased irritation and *vice versa*.

Large accumulations of fat and epidermis, due to seborrhœa, are sometimes observed in the umbilical fossa. In course of time this mass may become rancid and irritating, thus provoking increased secretion and accumulation. Seborrhœa genitalium is another example, which arises when, through want of cleanliness, smegma is allowed to collect and decompose.

**Acne Rosacea.** Some reciprocal correlations may be displayed in acne rosacea and account for its chronicity. The disease often begins with temporary but recurrent angio-neurotic flushing of the skin over the central portion of the face. In course of time these flushes give rise to a network of vascular dilatations associated with telangiectases and acne-like papules, resulting eventually in inflammation of the sebaceous glands. The telangiectases and the pustules appear to favour one another.

Brocq writes :

“A form of Vicious Circle is established. The inflamed acne favours the afflux of blood to the face, and aggravates the dilatation of the blood-vessels ; while, on the other hand, the chronic congestion of the skin favours the production of acne and the induration round the base of the pustules.”<sup>1</sup>

The latter stage of the disease is characterized by an enormous development of sebaceous glands and

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<sup>1</sup> Dermatologie Pratique, I., p. 831. Cf. also Pratique Dermatologique, I., p. 227.

fibrous tissue—changes which reciprocally aggravate one another (**Plate XIII. c**). The process is similar to that met with in rhinophyma and acne cheloid.

Wilfred Fox writes :

“The fibrous tissue obstructs further the sebaceous ducts, renders the outflow more difficult, and by stagnation favours additional pustulation, which in its turn produces fresh fibrous tissue, and so a Vicious Circle is set up.”<sup>1</sup>

#### (d) The Sweat Glands

**Hyperhidrosis.** General hyperhidrosis is met with in both acute and chronic diseases ; in both cases it may perpetuate its own cause. Almost every severe disease that is accompanied by great prostration may be complicated by excessive sweats, which, on the one hand, result from the state of exhaustion, and, on the other, aggravate such exhaustion.

Bouveret writes :

“The colliquative sweats of convalescence are nothing more than the expression of a state of profound weakness. . . . The convalescent perspires because he is weak, and this perspiration aggravates his weakness. This is a Vicious Circle from which he must escape without delay.”<sup>2</sup>

Perhaps the most violent attacks of hyperhidrosis are seen in tuberculosis, where they may cause complete soaking of the linen. The excessive sweats weaken the patient to an extraordinary degree and are said often to hasten the end.<sup>3</sup>

The same process in a less severe form is seen in neurasthenia, rheumatism and obesity. Neuro-pathic individuals not uncommonly are troubled

<sup>1</sup> Allbutt and Rolleston, *System of Medicine*, IX., p. 697.

<sup>2</sup> *Les Sueurs Morbides*, p. 121.

<sup>3</sup> *New York Medical J.*, 1918, II., p. 475.

by night sweats which perpetuate the nervous debility.<sup>1</sup>

In rheumatic persons, on the other hand, it is especially the skin over the affected muscles that sweats, but this is very apt to lead to chill and increased rheumatism.

Llewellyn and Jones write :

“A local hyperidrosis of the loins, by leading to soaking of the adjacent underclothing and consequently to local cooling, almost infallibly induces an exacerbation and thus a Vicious Circle ensues.”<sup>2</sup>

Some stout persons whose adipose tissues diminish the amount of heat given off by radiation and conduction, are much troubled by abundant perspirations. These make the sufferer lazy, and thus tend to increased obesity and perspiration (Plate XIII. d).

Hyperhidrosis of the axillary regions frequently causes women to wear impervious shields in order to protect their dress from unsightly stains. These shields, however, encourage retention and decomposition of the secretions, and thus favour irritation of the skin and further hyperhidrosis.

**Anhidrosis.** In persons who take too little exercise an inadequate amount of perspiration may also establish morbid correlations. The want of exercise causes anhidrosis, insufficient consumption of liquid, constipation, lassitude and a further disinclination for exercise.

**Dyshidrosis.** Some dermatologists have attributed pompholyx or dyshidrosis to disorder of the sudoriparous apparatus, although the matter is still under discussion. There can, however, be no doubt that the associated itching and scratching are both cause and effect of the disorder.

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<sup>1</sup> Müller, Handbuch der Neurasthenie, p. 166.

<sup>2</sup> Fibrositis, p. 174.

Brocq writes :

"The patient complains of intense itching and burning. The more he scratches himself the more numerous and the larger do the vesicles become. They seem almost to develop under the fingers at the itching spots as these are being rubbed."<sup>1</sup>

Retention cysts of the sweat glands may be due to the same mechanism as produces retention cysts elsewhere. Owing to the narrow lumen the sweat duct is readily obstructed or kinked, leading to accumulation of sweat and cystic dilatation. This may in turn cause further obstruction and accumulation, until the cyst reaches a considerable size.

#### IV. NEUROSES

All dermatoses are liable to be complicated by a neurotic element. But it will be convenient to group under a separate heading some conditions where the neuroses are predominant.

**Pruritus.** A familiar example is presented by pruritus, a disorder which may be independent of local irritation or of pathological changes in the skin. In some neuropaths who have suffered from pruritus the mere fear of an attack may suffice to bring it on. The liability is greatest in such a place as a church or a theatre, where there is no opportunity of gratifying the desire to scratch. The itching gradually increases in intensity, and when scratching can be indulged in the pruritus is further aggravated owing to increased reflex irritation. The phobia thus nourishes itself (**Plate XIII. e**).

After a period of pleasurable excitement a form of orgasm takes place accompanied by a discharge of nervous energy and a relief of the pruritus.

In cases of persistent pruritus there may be established what Unna calls the "*circulus vitiosus* of

<sup>1</sup> Dermatologie Pratique, II., p. 133.

scratching and hyperkeratosis,"<sup>1</sup> a correlation which has been strongly upheld by Brocq and Jacquet, although other dermatologists believe that a slight eczema or other lesion may start the process. If the scratching has been indulged in for long, a permanent change known as lichenification is apt to follow. This again perpetuates the pruritus, as Macleod has described :

"When lichenification is established, a Vicious Circle is set up, for the thickening of the skin irritates the nerve-endings and so keeps up the pruritus, whilst the rubbing which is indulged in to relieve the pruritus increases the lichenification."<sup>2</sup>

In other cases of long-continued pruritus innervation may be so disturbed as to produce an exaggerated activity of the reflex mechanism of scratching. The habit may persist after all peripheral lesion has disappeared. The condition resembles that occasionally met with in other muscular mechanisms such as blepharospasm, cough or vomiting.

Pruritus ani and pruritus vulvæ have been dealt with in Chapters VI. and VIII.

**Prurigo.** In prurigo also the neurotic element plays an important part. There has been much dispute as to whether the scratching gives rise to the papules or the papules to the scratching ; but whatever the primary cause the two conditions act and react on each other. Thus Sir Jonathan Hutchinson writes :

"Prurigo, from whatever cause it may have begun, tends to perpetuate or even to aggravate itself. It causes itching, and the itching causes scratching, and the scratching extends the prurigo, and thus the patient goes on from bad to worse."<sup>3</sup>

**Blushing.** Another nervous disorder is associated with blushing—a vaso-motor condition pro-

<sup>1</sup> Mraček, Handbuch der Hautkrankheiten, II., p. 306.

<sup>2</sup> Allbutt and Rolleston, System of Medicine, IX., p. 298.

<sup>3</sup> Lectures on Clinical Surgery, I. (i.), p. 30.



voked by emotional disturbance and showing itself by dilatation of the blood-vessels of the skin. It is especially common in nervous, self-conscious women. The more self-conscious, the more they blush. The harder they try to avoid blushing the worse they suffer (**Plate XIII. f**).

Roussy and Lhermitte write :

"Blushing and trembling are as a matter of fact simply reflex manifestations of an emotional temperament. Just as the blushing of an ereutophobe increases with the progress of his phobia, so the trembling of the tremophobe increases with his dread of trembling. The physical phenomenon creates the obsession which in its turn aggravates the physical reaction ; the aggravation of this latter similarly reacts on the mental trouble. Thus is established a Vicious Circle of reciprocal psychophysical reactions, of which the result is a real state of obsession."<sup>1</sup>

In some sensitive females ereutophobia has been a real martyrdom and destroyed all the happiness of life. Girls have had to abandon school life ; women have even contemplated suicide to escape their obsession. Facial seborrhœa in neurotic women may also be a self-perpetuating condition through a similar mechanism.<sup>2</sup>

In certain predisposed persons great mental anxiety or depression may provoke cutaneous eruptions, thus shewing how intimately the skin and nervous system are connected. The eruption naturally aggravates the neurosis.

Pernet writes :

"Continual mental stress and want of sleep may lead to a form of eruption on the skin which when widespread is in itself so irritating as to lead to further depression of the sufferer, in a word to what is called a Vicious Circle."<sup>3</sup>

<sup>1</sup> Les Psychonévroses de Guerre, p. 65.

<sup>2</sup> Kaposi, Diseases of the Skin, p. 123.

<sup>3</sup> The Health of the Skin, p. 19.

# Chapter Fifteen

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## VETERINARY DISEASES



ANY of the Vicious Circles occurring in the domestic animals are similar to those occurring in man, as indeed might be expected from their morphological and physiological affinities.

On the other hand domestic animals afford examples that are little known in human pathology, owing to peculiarities in structure and function. Amongst them are various forms of impaction of food in such regions of the alimentary tract as the peculiarly shaped stomach of the horse, the rumen of cattle or the crop of the bird. Again hairy, woolly or feathery coats favour parasitic disease to an extent that man happily escapes.

Attention may be drawn to a few examples which occur in the more important domestic animals, and which may serve to illustrate the morbid process. We may deal in order with the nervous, the cardiovascular, the respiratory, the digestive and other systems.<sup>1</sup>

### I. THE NERVOUS SYSTEM

**Apoplexy.** Cerebral hæmorrhage is less common in the domestic animals than in man since they are less subject to degenerative changes in the arteries. Nevertheless horses, cattle, dogs, birds and other animals suffer occasionally, and the hæmorrhage may perpetuate itself by the following mechanism:

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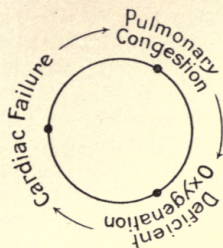
<sup>1</sup> Cf. also Veterinary Diseases and the Vicious Circle, by J.B.H., *The Veterinary News*, 1918, I., pp. 218, 226.

Under normal conditions the blood-pressure in the cerebral arteries is considerably higher than the intra-cranial pressure, being in horses equal to *ca.* 200-300 mm. Hg and in dogs to *ca.* 100-150 mm. Hg, while the intra-cranial pressure is practically nil. Cerebral hæmorrhage, however, raises the intra-cranial pressure nearly up to arterial pressure, and in so doing renders the vaso-motor centres anæmic. In their urgent need for blood these centres respond by a great splanchnic vaso-motor constriction, which may raise the pressure far above the normal level. Unhappily the rise is apt to prove disastrous by starting the hæmorrhage afresh. A further increase of intra-cranial pressure then results, and the whole sequence is repeated.

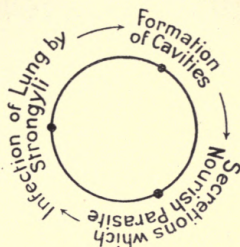
The increased blood-pressure frequently causes death by paralysis of the respiratory centre in the medulla.

**Hydrocephalus.** Chronic hydrocephalus is often complicated by the presence of a Vicious Circle which may lead to the destruction of the brain.

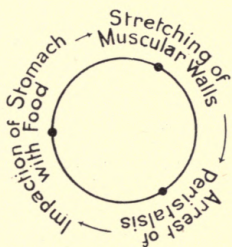
In health the cerebro-spinal fluid is continually being secreted by the choroid plexus into the ventricles, whence it escapes into the subarachnoid space, secretion and absorption being adjusted by a self-regulating mechanism. Various morbid processes, however, may narrow the communicating passages, causing an accumulation of fluid in the ventricles, which may so displace the adjacent parts as to increase the stenosis to which the dilatation was primarily due. For example, the tentorium cerebelli may be pushed down on the corpora quadrigemina and these in turn may press on the Sylvian duct, thus tending to diminish its lumen; the obstruction in turn increases the ventricular accumulation and so on. Such accumulation may lead to disastrous consequences. The pressure of



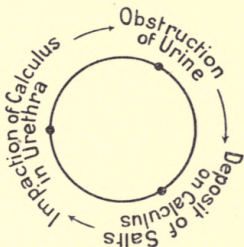
(a) CARDIAC FAILURE



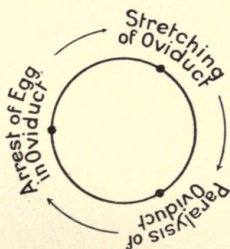
(b) STRONGYLUS INFECTION OF LUNG



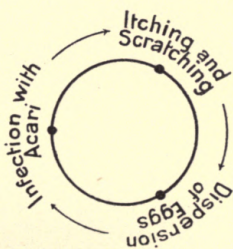
(c) IMPACTION OF STOMACH



(d) URETHRAL CALCULUS



(e) EGG-BINDING



(f) SCABIES

fluid in the ventricles stretches their walls which grow thin and weak. The more they stretch the thinner they grow and *vice versa*. The associated changes in the brain may be very striking. In the worst cases the cerebral tissues may be so compressed and stretched as to be reduced to a thin membrane, all trace of convolutions being lost, and the basal ganglia scarcely recognisable.

The changes caused by hydrocephalus are most readily effected in newly born animals, whose skull and membranes are yielding and the sutures unossified.

## II. THE CARDIO-VASCULAR SYSTEM

**Cardiac Disease.** Domestic animals frequently suffer from heart disease and such disease is complicated by a variety of circular reactions (**Plate XIV. a**). Striking examples are met with in horses which, whether used for draught or for racing purposes, are liable to excessive demands on the heart, which not uncommonly breaks down under the strain. The resulting disease, whether myocardiac or valvular, calls forth compensatory changes which tend to make good the insufficiency and may continue operative for a number of years.

Sooner or later, however, such compensation usually fails, and the heart becomes unequal to its work. The other organs that depend on the heart for their activity, such as the lungs, intestines, liver, kidneys etc. are then thrown into disorder. The processes of oxygenation, nutrition and elimination are impaired, while this impairment of vital functions reacts injuriously on the damaged heart, increasing its disability and aggravating its weakness.

Such a Vicious Circle may end in chronic invalidism or in death.



**Worm Aneurysm.** Another common disorder in horses is the so-called worm aneurysm due to the presence in the anterior mesenteric or other arteries of the larvæ of the hæmatozoon *strongylus vulgaris* (*sclerostomum vulgare*). These larvæ set up endo-arteritis, as a result of which the arterial walls grow weak, yield to the blood-pressure and form an aneurysm.<sup>1</sup> The more they yield the larger the aneurysm; the larger the aneurysm the greater the tension on the walls, since vascular tension increases with calibre. Thus the dilatation is progressive and the aneurysm may eventually rupture with fatal results.

The aneurysm and associated thrombosis may also cause serious circulatory failure in the intestines, followed by loss of peristalsis, stasis, fermentation and dilatation. These conditions aid and abet one another, so that further reciprocations are initiated.

### III. THE RESPIRATORY SYSTEM

**Chronic Catarrh of the Guttural Pouches.** An interesting Vicious Circle may be associated with chronic catarrh of, and retention of secretions in, the guttural pouches of the horse. The mucous membrane lining the pouches may from various causes become congested or inflamed, resulting in retention and decomposition of the secretions. Such decomposition leads to narrowing of the openings into the pouches and further obstruction to drainage. Thus the greater the obstruction the greater the irritation and *vice versa*. In course of time the retained secretions may form cartilaginous concretions or chondroids which set up further irritation. Concretions weighing as much as 2 lbs. have been recorded.<sup>2</sup>

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<sup>1</sup> Neumann, *Parasites and Parasitic Diseases of Domesticated Animals*, p. 622.

<sup>2</sup> Möller, *Operative Veterinary Surgery*, p. 92.

**Tuberculosis.** Tuberculosis is a wide-spread disease affecting many of the domestic animals and involving various organs in the animals attacked. The difficulty of eradication is largely due to the various Vicious Circles that are formed. Space will only permit of a few references to the disease as met with in cattle.

Bovine tuberculosis propagates itself in a variety of ways. For example, tubercle-laden sputa, when loosened by cough, may be aspirated into healthy parts of the lung, and thus start fresh foci. Or the sputa may be swallowed and infect the alimentary tract, whence the bacilli pass through the lymphatics and return to the lungs where the disease starts again, and where fresh materials are generated for expectoration.

The astonishing rapidity with which pulmonary cavities sometimes form and enlarge is also due to the operation of Circles. In some cases an entire lung may be destroyed, so that the bronchi open into a vast cavity bounded by little more than the pleura. The process may be the result of various causes. Thus a mass of caseous tubercles may be discharged into a bronchial tube, leaving a cavity of which the walls are in active tuberculous evolution. The larger the surface exposed to infection, the more rapidly does disintegration take place. Thus the cavity tends to grow eccentrically. Again the accumulation of the stagnant secretions greatly favours the multiplication both of the tubercle bacilli and of other pyogenic micro-organisms. These mixed infections accelerate the advance of the tuberculosis and tend to the further enlargement of the cavities.

With these and other Vicious Circles at work it is no wonder that tuberculosis is so destructive a disease. Moreover the tuberculous animal may disseminate infective sputa far and wide. All the

residents in a cow-shed may be infected by the introduction of one diseased animal.

**Emphysema.** The expression "broken wind" is loosely applied to several disorders, but is best restricted to a chronic emphysema of the pulmonary alveoli which is a steadily progressive condition due to the operation of Vicious Circles. The disease, frequently met with in the horse, may result from various causes, chronic bronchitis being perhaps the commonest. The bronchitis is often accompanied by severe coughing and by very tenacious expectoration which is expelled with difficulty. The cough leads to increased intra-pulmonary pressure as a result of which the alveoli yield and dilate. Their walls lose their natural elasticity and frequently a number of alveoli become confluent. The secretions tend to stagnate in the dilated alveoli and thus perpetuate the cough which in its turn promotes further alveolar dilatation. Thus the process is self-aggravating and as a rule is incurable.

In order to overcome the loss of elasticity in the alveoli a greater expiratory effort is required; indeed a double expiratory movement frequently takes place while inspiration is shorter than usual. A chronic dyspnoea is also often present, dependent on the pulmonary changes.

In course of time the circulation through the emphysematous lungs is impeded, as a result of which the right side of the heart undergoes hypertrophy, followed by a subsequent dilatation which increases both the bronchial congestion and irritation.

While the horse is at rest or doing light work respiration may be comparatively easy. But laborious work requiring a more abundant supply of oxygen severely taxes the emphysematous lungs. All the signs of respiratory distress show themselves.

In order to assist respiration the diaphragm acts more vigorously than usual, and as a result the abdomen frequently assumes a pot-bellied appearance.

**Lung-Worm Disease.** This disease, sometimes called verminous bronchitis, and caused by several species of strongylus, attacks domestic animals such as pigs, cattle, sheep and goats (**Plate XIV. b**). In pigs the strongylus paradoxus is the special parasite which inhabits the bronchial tubes and lungs, where it provokes congestion and the formation of large cavities known as worm-nodules.<sup>1</sup>

Both the trachea and bronchi may be dilated into sacciform pouches in which the worms lie coiled, surrounded by mucus, pus and other secretions from which they derive nourishment. The more numerous the parasites the greater the injury caused and *vice versa*. The affected animal may perish from asphyxia due to an accumulation of the worms.

**Syngamosis.** A common parasitic respiratory disease, popularly known as "gapes," is due to a nematode called the syngamus trachealis or wind-pipe worm which inhabits the upper part of the trachea and gives rise to tracheo-bronchitis in fowls and other birds.<sup>2</sup> The worms attach themselves by suction discs to the mucous membrane from which they suck blood. The larger the worms the more blood do they imbibe and *vice versa*. Adult fowls with a full-sized trachea are not much troubled; but in younger birds the entire trachea may be blocked, death taking place from asphyxia.

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<sup>1</sup> Friedberger and Fröhner, Veterinary Pathology, II., p. 700.

<sup>2</sup> Neumann, Parasites and Parasitic Diseases of Domesticated Animals, p. 606.

Half a million pullets are said to perish every year from the disease.<sup>1</sup>

#### IV. THE DIGESTIVE SYSTEM

**Impaction of Food.** Domestic animals are peculiarly liable to impaction of food in various portions of the digestive tract. The œsophagus, the stomach, the intestines, the rectum may all be affected by this dangerous complication, which depends partly on anatomical peculiarities and partly on the nature of food.

In cattle the region most often attacked is the rumen or paunch, a capacious sac capable of holding 50 gallons or more. This rumen is physiologically the first of three œsophageal dilatations (rumen, reticulum and omasum), the fourth compartment or abomasum being the true digestive stomach.

Most cows fill their rumen with enormous quantities of grass, especially when feeding on luxuriant turf, and no harm results. By means of rumination and peristalsis the ingesta are soon distributed to other portions of the alimentary tract where digestion proceeds.

In the case of a greedy feeder, however, the rumen is liable to be distended to such an extent that the muscular walls are overstretched and weakened, while peristalsis is diminished or even arrested. The ingesta are then retained, instead of being passed on, and undergo fermentation with the production of gas which causes further dilatation and weakness and adds to the trouble. Indeed such impaction, unless relieved, may end in rupture

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<sup>1</sup> Friedberger and Fröhner, *Veterinary Pathology*, II., p. 753.



of the rumen and speedy death. (Plate XIV. c).

Impaction of food in the œsophagus is also frequently met with in poultry and other birds, and goes by the name of ingluvial stagnation. After an unusually heavy meal the food may stretch the crop to such an extent that its muscular walls lose their power of contracting and of propelling the ingesta. The degree of distension may be quite extraordinary. Zurn met with a hen's crop which with its contents weighed 2 lbs. 14 oz. Another hen's crop had a circumference of 16 inches and a diameter of 6 inches.<sup>1</sup> The greater the dilatation the weaker muscular walls and *vice versa*. Occasionally the crop actually ruptures.<sup>2</sup>

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<sup>1</sup> Friedberger and Fröhner, *Veterinary Pathology*, II., p. 39.

<sup>2</sup> A fatal pathological Circle may be established in fleas which have been infected with bacillus pestis through sucking the blood of infected rats. When such fleas have swallowed plague bacilli these bacilli produce solid jelly-like colonies which multiply in the stomach and are prevented from returning to the proventriculus by an efficient valve which remains closed during digestion. Under certain circumstances, however, colonies grow in the proventriculus as well as in the stomach, when they not infrequently lead to complete blocking of the proventricular valve by a coherent mass of germs. As the wretched flea grows thirsty it sucks more blood which, however, cannot reach the stomach and so does nothing to quench thirst, while the gullet is more and more blocked. In other words the more the flea sucks the greater the obstruction and the less can it relieve its thirst. Occasionally the obstruction in the proventriculus undergoes autolysis so that the passage again becomes clear; otherwise the flea perishes from starvation or desiccation. Cf. Bacot and Martin, *Journal of Hygiene*, 1914 (Plague Supplement III.), p. 423.

Another form of impaction is frequently met with in the horse, whose stomach, owing to its small size and conformation, is peculiarly liable to suffer. In the first place the cardiac opening of the œsophagus is small and obstructed by thick folds of mucous membrane.<sup>1</sup> Moreover the œsophagus enters the stomach in an oblique direction, the opening being guarded by a powerful sphincter which acts vigorously when the stomach contracts and tightly occludes the lower end of the œsophagus. It is for this reason that the horse rarely vomits.

On the other hand the duodenum just beyond the pylorus forms a U-shaped bend, the limbs of which are readily compressed, when the stomach is over-distended. Thus both gastric orifices are easily blocked.

If a horse happens to indulge in an unusually large meal, or if fermentation processes increase the contents of the stomach beyond a certain limit, there is always a danger that the ingesta may become so tightly impacted in the stomach that even vigorous peristalsis fails to dislodge the mass. Indeed the peristalsis may, owing to the anatomical conformation, actually prevent all escape. The more vigorous the peristalsis the less the chance of relief and *vice versa*, so that a dangerous impasse is brought about, and the ingesta come to resemble "a pudding boiled in a cloth." In course of time the muscular walls grow exhausted and the animal, unless relieved, passes into a state of fatal collapse ; rupture of the stomach may be the immediate cause of death.

Almost every part of the intestines may be occluded as a result of the impaction of food, the

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<sup>1</sup> An illustration of the stomach is given by Chauveau, Comparative Anatomy of Domesticated Animals, p. 457.

details being similar in principle to those already described. A few words, however, may be added in reference to faecal impaction of the rectum. This disorder is common in dogs, and may be due to dry and concentrated food associated with insufficient exercise. If these or other causes have led to prolonged coprostasis, secondary reactions are frequently provoked which intensify the first.

Another common cause is the inability to obey the natural call at the natural hour, especially in the case of house-dogs trained to habits of cleanliness. The resulting accumulation of faeces distends and weakens the rectum, enabling it to hold more without discomfort and diminishing the power of defaecation. These conditions aid and abet each other and may result in obstinate coprostasis.

**Aërophagy.** Aërophagy or windsucking is frequently a self-perpetuating condition in horses, and probably originates in a gastric catarrh attended by flatulence, which the animals seek to relieve by the swallowing and eructation of air.

Owing to the powerful sphincter at the cardiac orifice and the oblique opening of the œsophagus into the stomach eructations are difficult to effect, unless something is swallowed at the same time so as to relax the sphincter. Consequently the horse gets into the habit of swallowing air so as to be able to belch up flatus. Unhappily, however, less air as a rule is belched up than is swallowed and so the stomach grows steadily larger. The greater the distension the more the horse resorts to air-swallowing, and so the process gradually becomes habitual. Flatulence and aërophagy aid and abet each other.

If the habit is practised with great frequency, the resulting gastritis reacts on the general nutrition. In severe cases the stomach may become excess-

ively distended, and this results in a complication known as gastric tympany. The intra-gastric pressure may then occlude both the œsophageal and pyloric openings. So completely indeed may both exits be blocked that if, after death, the gullet and the duodenum are divided the whole inflated stomach may be removed without any gas escaping.

**Intestinal Tympany.** Allied to the impaction of food is another dangerous condition, known as flatulent colic or intestinal tympany, which is frequently due to an animal having partaken of some food that readily ferments and evolves large quantities of gas, causing acute distension of the intestinal walls and arrest of peristalsis. The more the walls are stretched the weaker they grow, while the weaker they grow the more do they yield to pressure. According to some writers fermentative changes in the ingesta may also be caused by suppression of the secretions owing to anæmia, debility, febrile diseases or intestinal catarrh.

Hoare writes :

“Diminution or arrest of intestinal movements may depend on suppression of the secretions quite independently of actual obstruction of the bowel, and gives rise to excessive fermentation of the ingesta. Anæmia, debility, febrile diseases, chronic intestinal catarrh, etc., interfere with the normal secretions of the intestines. Severe work immediately after a period of repose, also over-exertion, interfere with the normal circulation of the intestine, and thus bring about indigestion and the formation of gases. The latter in their turn distend the intestinal walls, and diminish the blood-supply thereto, and also the secretions, so that a Vicious Circle is thus established.”<sup>1</sup>

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<sup>1</sup> A System of Veterinary Medicine, II., pp. 181, 531.

Such attacks of wind colic or tympany aggravate themselves, and appear incurable. But happily nature often wakes up to the danger before it is too late, and by a sudden violent increase of peristalsis expels the accumulated gases and breaks the Circle.

**Wool-Eating.** Wool-eating or mallophagia belongs to a group of habit Circles of which a variety of examples are met with. In the sheep the first impulse to wool-eating arises in some slight dyspepsia or want of food which creates the desire to nibble at something, since such nibbling gives satisfaction. Hence the trick is repeated and in course of time becomes habitual. The grooves of habit in the nervous system wear more and more deeply; the nerve centres grow more and more labile, so that repetition occurs on less and less provocation.

Another Vicious Circle is associated with pica or perversion of the appetite, which probably results from some dyspeptic condition which creates an abnormal and perverted sense of hunger. The affected animal will eat almost anything that offers, e.g. clay or even its own fæces. Such a diet naturally increases the primary dyspepsia. In course of time a chronic flatulence results and gives rise to a pot-bellied condition.

## V. THE GENITO-URINARY SYSTEM

**Hydronephrosis.** Hydronephrosis is a serious and not uncommon disease in cattle and other domestic animals. The disorder may be primarily due to unusual mobility of the kidney as a result of which the ureter is kinked, followed by an accumulation of urine in the renal calyces. Such accumulation causes an increased weight of the organ, a further descent in the abdomen and further obstruction to the escape of urine. Thus retention



begets retention. In course of time the pressure of retained urine may lead to hydronephrosis followed by gradual destruction of renal tissue. Indeed the kidney may be converted into an enormous cyst whose urinary functions have been lost.

**Urinary Calculi.** Urinary calculi may be associated with similar Vicious Circles as in man, and the details given above will apply.

In the domestic animals, however, some peculiar anatomical configuration may establish dangerous correlations of special interest. An example is met with in the bull which of all animals suffers most from urethral calculi (Plate XIV. d). The reason is to be found in the small lumen and extraordinary twist of the urethra which readily arrest the progress of any calculi that descend from the bladder. Not only is the urethral orifice narrowed to  $\frac{1}{8}$  inch, but the duct takes an S-shaped bend which cannot be traversed by the catheter, and at which even small calculi may be retained and cause obstruction of urine.<sup>1</sup> Such obstruction, if complete, may cause rupture of the bladder and speedy death. But if the obstruction is not complete the calculus forms a nucleus round which accretions accumulate. The larger the nucleus the more rapidly it grows and *vice versa*. Thus an obstruction that at first was only partial may become complete and prove fatal.

A very similar S-shaped curve is present in the urethra of the ram, another animal that suffers much from calculi.

**Milk Fever.** Milk fever is not uncommon in milch cows and is often complicated by dangerous circular reactions. The milk, after being formed

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<sup>1</sup>The S-shaped twist is well illustrated by Möller. *Operative Veterinary Surgery*, p. 321.

in the glandular tissues, flows into the milk ducts which convey it to a large cavity at the base of the teat termed the galactophorous sinus, there being one galactophorous sinus and teat for each division of the udder. From the galactophorous sinus a narrow duct lined with mucous membrane leads to the open air.

The causes of milk-fever are still obscure, but there is probably in many attacks some infection by micro-organisms, followed by inflammation of the parenchyma of the udder as well as of the galactophorous sinus, with narrowing of the effluent duct and stagnation of milk. Owing to this stagnation the milk tends to undergo decomposition, and this further aggravates the primary inflammation and irritation.

In some cases the inflammation leads to gradual narrowing of the duct followed by stagnation, putrefaction and further obstruction, eventually resulting in a completely closed abscess cavity. The severity of the disease varies with the virulence of the infective organisms and with other conditions, but a lethal result is not uncommon.

**Egg-Binding.** Another circular process is associated with egg-binding, and is due to an egg distending the oviduct to such a degree that the muscular walls are thinned and lose their power of contraction. Such paralysis arrests all progress, and this in turn perpetuates the distension and weakness (**Plate XIV. e**). Moreover the arrested progress of the egg causes the bird to strain violently and this causes swelling and inflammation, tending to increased obstruction.<sup>1</sup> In some cases the oviduct ruptures and allows the egg to pass into the peritoneal cavity, where dangerous peritonitis is set up.

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<sup>1</sup>Law, Veterinary Medicine, III., p. 295.

## VI. THE CUTANEOUS SYSTEM

Parasitic skin affections, such as scabies and ringworm, are frequently complicated by self-perpetuating conditions. The variety of such disorders is so great that only one or two examples can be given, but they suffice to illustrate the principle that the parasite is able to secure its own diffusion by means of the irritation excited by its presence (Plate XIV. f).

A common example is presented by the *sarcoptes scabiei* which infests the dog. This acarus sets up severe pruritus which the dog seeks to relieve by scratching and rubbing. As a result the paws become infected with the acari or their ova, and transfer them to other parts of the body where fresh outbreaks of the scabies are started.

Three forms of acarus are found in the sheep, but the most important variety is the *dermodectes communis* which gives rise to the dermodectic mange. In some countries a majority of the sheep are affected.

The parasites chiefly attack parts of the body that are covered with wool, since this affords them protection. Abundant vesicles and pustules are formed, giving rise to secretions which glue the wool together and create large scabs. The eruption is often accompanied by violent itching which compels the animal to rub and scratch itself. By this means the acari are readily transferred to fresh areas where they spread the disease. The scabs also favour the multiplication of the acari, since such shelter supplies food, warmth and protection.

Another cutaneous disorder in sheep is due to the *tinea tonsurans* which leads to felting of the wool beneath which scabs form. Here also considerable itching may be caused by the infecting fungus, and such itching leads to the transference of spores to

healthy areas by means of the feet or lips.

Birds often suffer from the form of ringworm known as the *achorion schönleinii*, which gives rise to favus or fowl mange. The eruption frequently starts on the comb or ears, whence it gradually spreads until the entire comb and even the whole body is covered with a mouldy deposit. The secondary itching provokes scratching and is largely responsible for the rapid diffusion of the spores.

This brief account of some Vicious Circles in Veterinary diseases will, it is hoped, suffice to illustrate their importance. There is ample scope for a volume dealing with this morbid process in zoo-pathology, and especially with the best methods of arresting it.



# Chapter Sixteen

## PLANT DISEASES



IN the Chapter devoted to Aetiology the Vicious Circle in animal and plant diseases was attributed to a disturbance of the physiological correlations present in all organised living things. There is, however a striking difference in the morbid process as met with in animals and in plants. In the former owing to the higher differentiation of organs numerous specific *circuli vitiosi* are met with. A specific lesion gives rise to a secondary specific lesion which in turn aggravates the primary one, and this endless chain can be studied link by link.<sup>1</sup>

Future research may reveal similar conditions in plant pathology. But at present specific reactions of morbid processes have been but little studied in plants. On the other hand the general principle of the Vicious Circle is in universal operation. Lowered resistance due to one or more adverse circumstances renders the plant susceptible to some injurious factor, such as parasitic infection, which in its turn further lowers resistance. The death of plants frequently results from this morbid process.

Lowered resistance may be due to a great variety of causes. Amongst them are unsuitability of soil, temperature or climate, and excess or deficiency of water. According to recent researches by Appel<sup>2</sup>

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<sup>1</sup> Cf. also Plant Disease and the Vicious Circle, by J.B.H., *J. Royal Hort. S.* (1919), XLIII., p. 309.

<sup>2</sup> *Gardener's Chronicle*, 1915, II., p. 322.



excess of air in the tissues associated with insufficiency of water acts in the same direction.

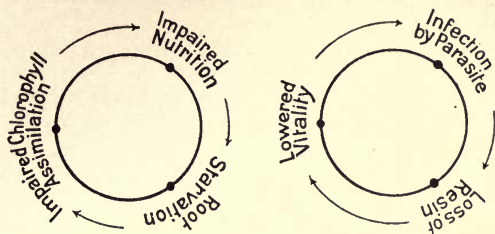
Another cause is immaturity of tissue. The epidermis in early life is both tender and thin, and may be penetrated by bacteria or fungi that are powerless to injure plants whose epidermis has become cuticularised or replaced by cork. On the other hand advanced age also predisposes to infection. In young coniferous trees well provided with resin canals injuries of the cortex are at once sealed by an exudation of turpentine and thus protected from wound fungi, while in older trees turpentine and resin are less freely exuded as styptics. Again wounds are more slowly occluded by callus in old age than in youth. Such predisposing factors enable organisms successfully to effect an entrance, and further to weaken the host.

Parasitic invaders may abstract their food from the host-plant by various methods. Some ramify in the inter-cellular spaces and middle lamellæ; others send haustoria into the actual cells. Many secrete enzymes or toxins which destroy cells or cell-walls, the materials of which then promote further growth and proliferation of the parasites. Hence fresh enzymes or toxins are secreted for the destruction of remoter cells, which in their turn fall a prey to the ever-spreading invader. The morbid process *vires acquirit eundo*.

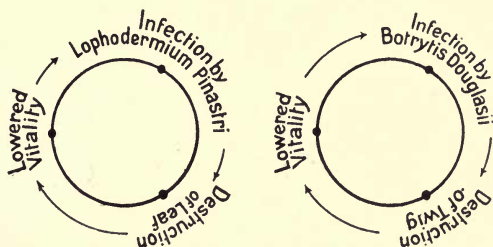
The effects of injurious circular reactions may be briefly discussed under three headings:

- I. The Perpetuation of Disease
- II. The Destruction of Organs
- III. The Termination of Life

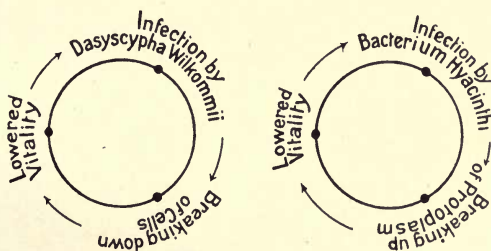
These groups, however, are by no means sharply defined; diseases placed in I. and II. may under exceptional conditions prove fatal, while diseases



(a) THE PERPETUATION OF DISEASE



(b) THE DESTRUCTION OF ORGANS



(c) THE TERMINATION OF LIFE

Plate XV.—Circles associated with  
Plant Diseases.

placed in III. may be so chronic as scarcely to shorten the duration of life.<sup>1</sup>

## I. THE PERPETUATION OF DISEASE

The perpetuation of a disease through insufficient chlorophyll assimilation has already been referred to (p. 3). In other cases the morbid condition may be initiated by living organisms (**Plate XV. a**). Both the true fungi as well as Schizomycetes (Bacteria) and Myxomycetes (Slime Fungi) may be concerned.

**Peridermium Pini.** A striking example may be found in the case of pine-blister caused by the *Coleosporium Senecionis* (*Peridermium Pini*, var. *corticola*), a fungus which attacks the cortex of the Scotch and Weymouth pines amongst others. The hyphæ grow in between the green cells of the cortex as well as in the bast-tissues, and may even penetrate the medullary rays and resin-canals. Other hyphæ pierce the cells, consume the starch and other food-stuffs, and cause a serious loss of resin which both soaks into the wood and exudes from the bark. This loss of resin involves a serious impairment of vitality. Moreover the effusion of turpentine into the wood interferes with conduction of sap in these tissues and lowers the nutrition of the tree, especially above the point of attack, since the flow of sap is checked.

Meanwhile the parasite nourishes itself on the juices which it has liberated and on the contents

<sup>1</sup> Many beneficent circular reactions occur both in plants and in animals. Thus in the healthy plant the leaves, the roots and other organs are reciprocally dependent on each other and "enable the ideally correlated system to go on working at maximum energy" (Ward, *Disease in Plants*, p. 94). A more specific process of reciprocation is associated with leguminous plants and the presence of nitrifying bacilli. More vigour : more galls : more nitrogen : more vigour—constitute the sequence.

of the cells it has invaded. Thus a struggle takes place which may last for many years. If the tree is vigorous it may, by the diversion of metabolic material, form sufficient cork to shut in and suffocate its enemy. But as a rule the invader extends his ravages and converts a robust thriving tree into a dwarfed sickly one. The more the parasite can arrest the flow of sap and the greater the loss of resin the more is vitality impaired, and the less the vitality the more rapid the progress of the invader. Cause and effect aid and abet each other, and the result is a chronic invalidism of an enormous number of trees that are attacked by this disastrous disease.

A similar process is frequently observed as a result of bacterial invasion. Erwin F. Smith has described a number of leaf-spot diseases in which the parasite penetrates through stomata in the unbroken leaf and stem surface, and multiplies in the substomatic chamber, causing a local destruction of tissue. Thus *Bacterium phaseoli* is responsible for the spot disease of beans, *Bacterium maculicolum* for the spot disease of cauliflowers, and other examples have been observed. Leaf spots are often slow in their progress and confined to small areas, the reason probably being that the vascular system is not invaded. Nevertheless the bacteria weaken or destroy the cells of their host. With increasing supplies of food and a nidus rendered alkaline by their own excretions the bacteria multiply more and more, unless indeed, as sometimes happens, the host can arrest the process by separating the diseased from the healthy tissues by the formation of a corky layer.

## II. THE DESTRUCTION OF ORGANS

Another result of an injurious circular reaction is the destruction of an organ either by a non-living or a living agency.

The effect of a non-living agency is illustrated

by the premature shedding of leaves or of twigs which may be thrown off in great numbers as a result of organic tissue changes (**Plate XV. b**).

The disorder is most often observed in the case of leaves, and is initiated by an impairment of assimilation and transpiration processes, as a result of which the suction force by which under healthy conditions the sap is drawn up is lost. Consequently the sap accumulates in the basal leaf zone through which the line of cleavage ultimately passes, and which becomes excessively turgid with osmotic materials. This turgor stimulates to premature activity the dormant cells of the abscission layer; the partition wall between adjacent cells swells and a process of dissociation is inaugurated. The effect is a further impairment of vitality of the leaves, culminating in complete detachment. To quote Sorauer: "Every premature shedding of leaves is due to a disturbed equilibrium in the distribution of turgor."<sup>1</sup> In other words the process of premature cleavage is due to an arrest of metabolic activity causing pathological turgor at the basal zone, followed by a progressive loss of activity.

A similar process accounts for the premature shedding of twigs or shoots, which may occur as early as July. The oak and the poplar are frequently affected, the ground being in some cases thickly strewn by the detached twigs.

The destruction of organs may also be due to the attacks of parasites, some of which display a preference for certain organs, such as leaves, twigs, tubers or buds. A lowered state of vitality predisposes to such parasitic invasion which then further lowers nutrition, culminating in the total destruction of the organs.

**Lophodermium Pinastri.** As an example of a parasitic leaf-shedding disease may be mentioned

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<sup>1</sup> Pflanzenkrankheiten, I., p. 357.



the Pine Needle-cast caused by the fungus *Lophodermium Pinastri*, also called the Pine Leaf-scurf or leaf-shedding fungus.

The disease chiefly attacks the young and tender leaves of the Scots and Austrian Pines and other Conifers, and may cause many of their leaves suddenly to wilt and drop. The needles when first attacked are merely speckled with brown spots containing the mycelium of the fungus; but in the following year they wither, turn red or brown and die off in hundreds. This loss of leaves seriously weakens the plants and thus hastens the progress of the disease. The greater the loss of foliage the less the power of resisting infection. It is for this reason that the parasite is most destructive in shut-in valleys or low-lying situations where the trees possess least vitality and consequently succumb most readily.

The destruction of twigs is often brought about by infection with the *Botrytis Douglasii*.

**Ustilago.** Another illustration of a similar process may be found in the operations of the cereal smuts (*Ustilago*), which attack such grains as are rendered liable to infection by lowered vitality. The smuts reduce the ovules to a black powdery mass of spores which are carried away on the wind or otherwise dispersed, leaving nothing but the bare axis on which the flowers were originally situated.

### III. THE TERMINATION OF LIFE

Many examples might be given of the destruction of plants as a result of a Vicious Circle. It was formerly supposed that disease in animals was usually caused by bacteria, while diseases in plants was almost invariably due to fungi. But recent research has shewn that even in plants many bacterial diseases occur. Both Schizomycetes and Myxomycetes may be concerned (Plate XV. c).

E. F. Smith thus describes the process by which bacteria can provide for their own indefinite multiplication; when once a foot-hold has been secured :

“Enzymes, toxines, acids and various by-products of the bacterial growth also undoubtedly play their part, weakening the cells of the host or destroying them outright. With increasing supplies of food, and a nidus rendered suitably alkaline by their own excretions, the bacteria multiply more and more, obstructing some tissues and dissolving, displacing and crushing others. The tissues are poisoned more and more by absorption of the continually increasing quantity of bacterial by-products, cells are separated, cell-walls are softened or dissolved, protoplasm, amids, acids, starch, and sugars are consumed. Beginning, therefore, with a tiny superficial nidus in an open wound, a facultative parasite gradually burrows its way into the deeper tissues, forming closed cavities or open wounds, and finally destroying the entire plant or limiting its operations to special organs, as the case may be. Such is the impression one gets from a study of wound-infections.”<sup>1</sup>

Two fatal diseases may now be described, one due to a fungus and one to a bacillus.

**Dasyscypha Willkommii.** The well-known larch canker, associated with the invasion of the *Dasyscypha Willkommii*, is an example of a fungoid disease which is responsible for the loss of an enormous number of trees in our woodlands. The larch is indigenous in the Alps where there is a long winter season, followed by a short or no spring, and by a short hot summer. Owing to the rapid transition from winter to summer the larch buds open very rapidly when once they start. Hence the period during which the foliage is young and tender, and susceptible to attack is very short, since the tree passes rapidly into its summer state with its increased power of resistance. When, however, the larch is planted in such a country as England,

<sup>1</sup> Bacteria in Relation to Plant Diseases, II., p. 51.

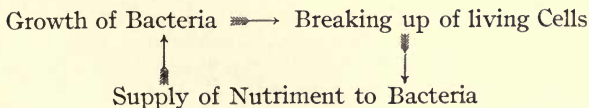
with a mild winter and a long and damp spring, the period of foliation extends over six or eight weeks, instead of two as in the Alps, so that insects and fungoid enemies have a much longer period during which to do damage.

The great enemy of the larch is the *Dasyscypha Willkommii*, which effects a lodgment in wounds in the young leaves and shoots made by plant lice (*Chermes laricis*) or the mining-moth (*Coleophora laricella*), or by some other agency which breaks the surface continuity. In such a wound the spores find a favourable nidus, whence the mycelium penetrates into the cortex during the quiescent period of winter.

If the tree has sufficient vitality, it may succeed during the period of active growth in cicatrising the canker-spot, by surrounding the blister by a tough corky layer and thus arresting its progress.

But, under less fortunate conditions, when autumn returns the mycelium penetrates further into the cambium and enlarges the canker-spot. Eventually it reaches the wood and interferes with the flow of sap. The further the invader advances, the more is the resisting power of the host-plant weakened, while such loss of resistance quickens the progress of the fungus. In course of time the tree sickens and dies.

**Bacterium Hyacinthi.** The yellow bacteriosis of hyacinth bulbs may serve as an example of a specific and fatal bacterial disease, due to the *Bacterium Hyacinthi*. Healthy bulbs are rarely attacked; but if a wound or other injury has impaired vitality infection readily follows. The sequence may thus be represented :



In the early stage of bulb infection the disease is confined to the vascular bundles, from one to fifty of these being yellow and full of bacterial slime ; but at a later stage the disease spreads to the intervening parenchyma, and finally the whole bulb is destroyed.

These examples of injurious circular reactions in phyto-pathology might be indefinitely multiplied ; but they suffice to indicate the operation of a wide-spread principle. The process belongs to those fundamental biological phenomena which are common to both the higher animals and plants. Within the limits of health organisation is of unquestioned advantage. On the other hand the liability to pernicious and reciprocal correlations is a serious penalty paid for such organisation, when physiological processes are disturbed by disease.

The simpler organisation of plants probably explains why this complication of disease is so much less specific than it is in zoo-pathology. Another reason is that in the animal every organ is fully developed and performs its functions to the utmost, while in the plant there are always present the rudiments of new organs as well as accumulations of reserve materials, and each of these provisions can assist in making good any failure of functional activity. A further explanation may be found in the more intimate union of cells in the animal as compared with the plant, allowing, as it does, of closer inter-dependences.

Apart from these reasons, however, there can be little doubt that with the growth of our knowledge of correlations in plants many examples of specific *circuli vitiosi* will be revealed. A further proof will thus be supplied of the essential unity in the laws governing animal and vegetable pathology.

## Chapter Seventeen

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### THE VICIOUS CIRCLE AS A CAUSE OF DEATH



VICIOUS Circles may exert an injurious influence in three directions : the perpetuation of disease ; the destruction of organs ;<sup>1</sup> the ending of life. Numerous examples of each of these effects have been given in the preceding pages. But it may be useful to emphasise the fatal influence of this morbid process and to shew how common is *mors ex circulo vitioso*. The expectation of life is materially affected by this complication of disease.

It has been pointed out above that the Vicious Circle usually arises through disorder in an organ or part of an organ creating disorder in other organs or parts of organs, the reaction of which aggravates the primary disorder. The evil is therefore one of the penalties paid for specialisation of structure and function, and is only encountered in the higher members of the animal and vegetable kingdoms which have reached a certain stage in organic evolution. The gravity of the complication naturally depends on the importance of the organs affected and on the nature of the morbid process at work.

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<sup>1</sup> As illustrations of the destruction of organs may be mentioned the brain in hydrocephalus, the eye in glaucoma, the kidney in hydronephrosis and the lung in tuberculosis.



Many years ago Bichat sought to distinguish between death by the heart, death by the lungs and death by the brain.<sup>1</sup> Such a classification cannot be accepted in the light of modern pathology, since we know that, by whichever gate-way danger first approaches, actual death results from the arrest of all the vital functions. Nevertheless, as a matter of convenience, we may associate deaths with the same triumvirate of vital organs and describe :

- I. Deaths associated with the Vascular System
- II. Deaths associated with the Respiratory System
- III. Deaths associated with the Nervous System

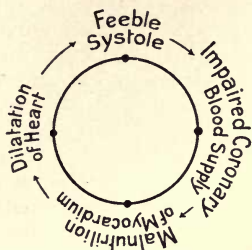
Wynn Westcott found that the chief factor in sudden death was cardiac in 60 per cent., cerebral in 30 per cent. and pulmonary in 10 per cent.<sup>2</sup>

#### I. DEATHS ASSOCIATED WITH THE VASCULAR SYSTEM

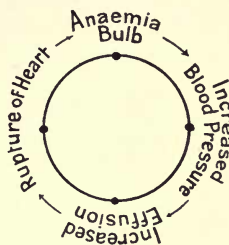
**Heart Failure.** Heart failure ranks as one of the commonest modes of death, and occurs under a great variety of circumstances (Plate XVI. a). For example, acute cardiac dilatation may weaken the coronary circulation to such a degree that insufficient blood reaches the myocardium to allow of its continued activity. The less the blood supplied to the myocardium the feebler the systole and *vice versa*. This sequence probably caused the death of the famous soldier Eucles who raced to Athens with the news of Marathon, shouting *χαίρετε, χαίρομεν*, and dropped dead on arrival. The prolonged strain led to high blood-pressure, to cardiac dilatation, to inadequate coronary circula-

<sup>1</sup> Recherches sur la Vie et la Mort.

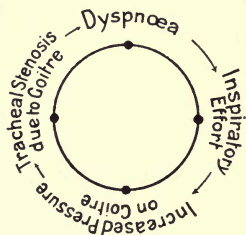
<sup>2</sup> *British Med. J.*, 1908, I., p. 491.



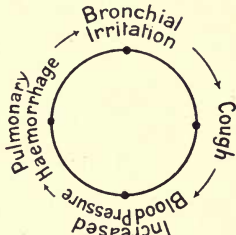
(a) DEATH FROM CARDIAC DILATATION



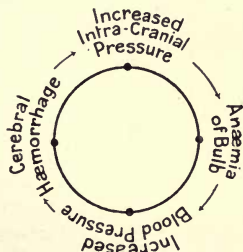
(b) DEATH FROM CARDIAC RUPTURE



(c) DEATH FROM ASPHYXIA



(d) DEATH FROM PULMONARY HÆMORRHAGE



(e) DEATH FROM CEREBRAL HÆMORRHAGE



(f) DEATH FROM SHOCK

Plate XVI.—The Circle as a Cause of Death.

tion, to inadequate nutrition of the myocardium, to further dilatation and finally to syncope.

Death frequently results from coronary obstruction due to sclerosis, a condition which accounts for the death of many elderly persons, to whom the end comes like a "bolt from the blue." The morbid process has probably been in progress for years, until a stage is reached when the lumen of one or both coronary arteries is seriously narrowed by degenerative processes. The exaggerated *vis a fronte* requires an increased *vis a tergo*, if life is to continue, whereas the diminished coronary blood-supply actually weakens the force of the systole. In other words the defective coronary circulation and the myocardiac weakness progressively aggravate each other, until death closes the scene. Fatal angina pectoris may be due to this sequence of events, some unusual effort, with its extra requirement of blood, proving the proverbial last straw. Syncope may be instantaneous, coeval with a single pang, attitude and expression remaining perfectly placid. No blood, no systole here represents the mechanism of death.

In other cases the fatal issue may be due to the reciprocal action of cardiac venous engorgement and cardiac malnutrition. As the heart grows incompetent, the coronary veins are the first to feel the back pressure and their congestion interferes with the circulation through, and therefore with the nutrition of, the heart.

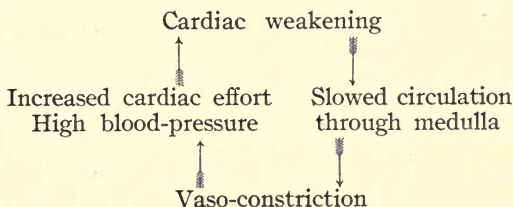
S. West thus describes the pathological sequence :

"If the nutrition is thus affected, the muscle will be weak, and the heart will dilate. This weakness still further increases the venous congestion, which in turn increases the weakness again. So a Vicious Circle is established, and an explanation given to the extraordinary rapidity with which the heart failure often develops when once it has set in."<sup>1</sup>

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<sup>1</sup> *British Med. J.*, 1905, II., p., 1032.

Another dangerous condition is the paradoxical association of an over-strained and weakened heart with an abnormally high blood-pressure. The slowing of the circulation tends to produce anæmia of the medullary centres, which respond by inducing vaso-constriction in order to bring about increased pressure and so to secure a larger quantity of blood. The already weakened heart is thus called upon for a supreme effort, and the weaker it is the more do the imperious medullary centres insist on more blood. At length comes a moment when the pressure within the weakened ventricle is raised beyond endurance. Suddenly, in accordance with the "all or nothing" law, the heart stops in diastole. The process is thus graphically represented by Hirschfelder : <sup>1</sup>



Some fatal correlations also occur in connection with valvular disease. For example, an aortic valve may rupture during violent exertion, the regurgitating blood throwing a sudden and severe strain on the heart, which has no time to accommodate itself to altered conditions. Dilatation of the ventricle follows, with a feebler systole, increased regurgitation and in severe cases immediate death.

Amongst the various forms of chronic valvular disease, stenosis and incompetence of the aortic orifice, associated with dilatation of the ventricle,

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<sup>1</sup> Diseases of the Heart and Aorta, p. 315.

most frequently lead to death. After perhaps many years of fairly comfortable life, the compensatory hypertrophy wears out and is replaced by further dilatation. The fatal sequence may be summarised thus : regurgitation, dilatation, weakened systole, impaired coronary circulation, further dilatation and increased regurgitation.<sup>1</sup>

Another fatal sequence is common in patients suffering from mitral stenosis.

Coombs writes :

“In a large majority of all cases of mitral stenosis death is due to gradual cardiac failure. The forces responsible for this are two. The heart, and especially the left auricle, is asked to do more work by reason of the valvular obstruction ; and generally increasing venous stasis undermines the nutrition of the cardiac, and particularly the auricular, musculature. An unconquerable Vicious Circle is thus established. The results are pulmonary engorgement, auricular breakdown, and ultimate ventricular failure.”<sup>2</sup>

Sudden death is sometimes due to thrombosis or embolism of the heart or large vessels. If not immediately fatal, the embolus or thrombus may cause eddies and obstruction which in their turn lead to rapid and extensive clotting. This steadily adds to the size of the embolus or thrombus, thereby increasing the obstruction. The greater the obstruction the larger the surface on which the blood can coagulate, and the more rapidly does the obstruction grow.

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<sup>1</sup> According to Manson the reciprocal influence of cardiac dilatation and weakness accounts for death in many cases of beriberi. “Gradually the right side of the heart becomes more dilated, and in proportion to the dilatation more weakened, passing into one of those hopeless Vicious Circles so common in pathology.” Davidson, *Hygiene and Diseases of Warm Climates*, p. 473

<sup>2</sup> Short, *Index of Prognosis*, p. 320.



**Pericardial Effusion.** Interference with diastolic filling, owing to pericarditis or to rupture of an aneurysm, is frequently fatal, since such interference prevents the stretching of the cardiac muscle which is so essential to the full development of its energy. A case in which death occurred from this cause is described on p. 52.

**Congenital Heart Disease.** Congenital morbus cordis is not an uncommon cause of death, and has been already alluded to in Chapter IV. Sometimes the demise may be due to an open foramen ovale. This malformation is usually complicated with pulmonary stenosis which allows enough blood to reach the lungs, so long as a quiet mode of life is pursued, while the remainder of the blood passes through the foramen ovale. If, however, violent exercise is taken, more blood must pass through the foramen directly to the left side of the heart and thus escapes aëration. The result of the venosity is a rise in blood-pressure, which again causes more blood to be driven through the foramen, ending at times in speedy death.

**Rupture of Heart.** Spontaneous rupture of the heart may be due to progressive degenerative changes and dilatation of the cardiac muscle (Plate XVI. b). As the strain on the walls of a sphere or spheroid increases with its circumference, so the heart dilates the more the greater the strain on its walls, leading to further dilatation and occasionally to rupture. When rupture has occurred, the primary loss of blood stimulates the vaso-motor centre, which stimulus calls forth a general vaso-constriction, raises the blood-pressure, and thus intensifies the hæmorrhage. A similar sequence may be associated with rupture of an aneurysm or a penetrating wound of the heart. Probably King William Rufus died from perforation of his heart by Walter Tyrel's

arrow, which "per medium cordis regem sauciavit qui subito mortuus corruiit."

## II. DEATHS ASSOCIATED WITH THE RESPIRATORY SYSTEM

**Asphyxia.** Asphyxia, due to the interruption of respiration, is a frequent cause of death, and may occur under a variety of conditions.<sup>1</sup>

In consequence of the obstructed respiratory exchange the venosity of the blood increases, respiratory movements grow more vigorous, blood-pressure rises, and the heart is slowed by the cardio-inhibitory centres in the medulla. The increased pulmonary obstruction then causes the right heart to become gorged with blood, and eventually dilated and weakened. This in turn leads to further venosity which poisons the myocardium and tends to further dilatation, until at length the right auricle and ventricle lose all power of contracting. A similar process also involves the left side; but the progressive dilatation of the right side plays the chief rôle, and contributes mainly to the fatal exitus (Plate XVI. c).

Pulmonary atelectasis is frequently fatal in weakly or rickety infants, whose death gives rise to great consternation, since what appeared at first to be a trifling catarrh may suffice to start the fatal sequence. Any accumulation of secretion is liable in such weaklings to diminish the quantity of air entering the air cells, and such diminution favours a further accumulation. The associated venosity of the blood may, through interference with the normal reflexes, constitute an aggravating factor.

The gradual asphyxia which so often supervenes during the terminal stage of illness is also com-

<sup>1</sup> A case of death due to the Vicious Circle associated with goitre and tracheal stenosis was published by the author in 1887. *Lancet*, 1887, I., p. 570.

plicated by a circular reaction. The shallow respirations do little to aërate the blood, and thus induce narcosis of the respiratory centre, still shallower respirations and death. This is indeed a merciful process which leads to a peaceful painless end. Nature often provides her own anæsthetic for us at the last.

Asphyxia neonatorum is often complicated by a Vicious Circle and may result from any condition which leads to an accumulation of CO<sub>2</sub> in the blood of the fœtus. The danger arises from the fact that such accumulation may prematurely interrupt the state of apnœa which should persist during intra-uterine life.

If CO<sub>2</sub> accumulates beyond a certain point, it stimulates the respiratory centre so that the fœtus makes its first respiratory effort and inspires amniotic fluid if the amniotic sac is intact, or that fluid mixed with blood and mucus if the sac has burst. Thus as in the case of a drowning person inspiration does little toward oxygenation, but tends rather to further accumulation of CO<sub>2</sub>. Moreover during the state of apnœa the lungs receive but little blood, since the powerful right auricle propels the greater portion of its blood through the ductus Botalli into the aorta. With the first inspiratory effort, however, the blood in the right auricle is aspirated into the pulmonary artery instead of passing directly into aorta. The result is that the blood-pressure in the aorta falls considerably, leading to further venosity. Unless speedy relief is forthcoming, the respiratory centre is paralysed by the excess of CO<sub>2</sub> and death supervenes from what Lenzmann calls "a very grave Vicious Circle."<sup>1</sup>

Asphyxia may also prove fatal before a single respiration has taken place when the accumulation

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<sup>1</sup> Emergencies in Medical Practice, p. 17.

of CO<sub>2</sub> is so gradual as never to reach the limit of stimulation. In such cases the acid increasingly narcotises the respiratory centre and renders it less and less susceptible to stimulation until death takes place.<sup>1</sup>

**Hæmoptysis.** Hæmoptysis may be complicated by dangerous correlations which are largely responsible for the profusion and prolongation of the hæmorrhage (Plate XVI. d). In the first place the irritation of the effused blood induces cough; coughing, like any other exertion, raises blood-pressure; increased blood-pressure is apt to renew the hæmorrhage. Thus in a severe attack a person may be choked in his own blood. Mental excitement supplies an aggravating factor, as it also does in the allied condition of hæmatemesis. Such excitement may produce a rise of as much as 40 mm. Hg in the systolic pressure. Lastly, we may have the same general vaso-constriction due to anæmia of the vaso-motor centre that has already been alluded to. These factors, acting cumulatively, adequately explain the fatal hæmoptysis that is sometimes met with. A man may cough himself into his grave.

A similar mode of death may result from the perforation of an empyema into the respiratory passages. Every cough, although an act of self-defence, increases the flow of pus, which may flood the passages, in spite of vigorous expectoration.

Pick and Hecht write :

"The more the patient coughs, the more profusely the pus streams into the bronchi as a result of the expiratory rise in pressure, and such a *circulus vitiosus* can only end in death."<sup>2</sup>

<sup>1</sup> Lenzmann, Emergencies in Medical Practice, p. 18. Cf. also Schultze, Der Scheintod Neugeborener, pp. 77-8, III.

<sup>2</sup> Clinical Symptomatology, p. 259.

The condition is, however, by no means so hopeless as Pick and Hecht suggest.

Other fatal disorders associated with the respiratory tract will be found in Chapters V. and XII.

### III. DEATHS ASSOCIATED WITH THE NERVOUS SYSTEM

**Apoplexy.** Cerebral hæmorrhage may prove fatal through the intermediary of a striking circular reaction. The causal factors have already been described (p. 29) and need not be repeated. Where death supervenes rapidly, the effused blood has probably compressed and paralysed the vagal and respiratory centres in the medulla. Such a course of events, however, is uncommon ; the fatal issue is more often due to another sequence in which exhaustion of the vaso-motor centre leads to splanchnic dilatation, cerebral and cardiac anæmia, further exhaustion and death (Plate XVI. e).

**Vaso-motor Paralysis.** Death is sometimes due to inhibition or paralysis of the vaso-motor centres as a result of terror or other strong emotion (Plate XVI. f).

During health the activity of those centres is increased or diminished according as arterial pressure falls or rises. But strong emotion may paralyse the vaso-motor mechanism ; the splanchnic sluice gates are opened, the blood-pressure falls, the cerebral vessels are emptied, with the result that the depression of the centres is accentuated, possibly beyond recovery. The heart too may be involved in the injurious process, since, owing to the progressive accumulation of blood in the splanchnic area, an insufficient quantity may return to the heart to enable the circulation to be carried on. The defective coronary circulation still further weakens the myocardium, with the effect that the heart may suddenly stop in diastole. This is probably the mechanism



of death in various forms of shock, in the collapse often met with during acute disease,<sup>1</sup> in severe diarrhoea, in perforation of abdominal viscera etc.<sup>2</sup>

**Convulsions.** Convulsions are not infrequently a cause of death, owing to the associated increased vensity of the blood which may be both the result of preceding, and the cause of subsequent, convulsions. Such a sequence is commonly observed in the status epilepticus, as has been already explained on p. 28.

**Hydrocephalus.** Death is occasionally met with in cases of hydrocephalus, when the fluid has accumulated in the ventricles owing to a mutuality of cause and effect. The primary lesion may be some obstruction in the communicating channels, leading to dilatation of the ventricles. The dilated ventricles may then so displace the adjacent parts as to press on, and increase, the obstruction in the narrowed channel to which the accumulation of fluid was primarily due. For example, the cerebellum and medulla may be pressed down into the foramen magnum so as to plug that aperture. Such plugging in turn increases the distension of the ventricles, raising the pressure to such a level that the respiratory centre is paralysed.

These illustrations suffice to establish the proposition that the fatal issue of disease is frequently due to the operation of an injurious reciprocation of disorders.

Similar conditions are operative in many forms of violent death, e.g. drowning, hanging, cut-throat and poisoning.

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<sup>1</sup> A 50 p.c. mortality in attacks of influenzal bronchopneumonia is attributed by Symonds to the Vicious Circle of toxæmia and nephritis. *Lancet*, 1918, II., p. 665.

<sup>2</sup> Heineke, Die Todesursache bei Perforationsperitonitis, *Deutsches Archiv f. klin. Medicin* (1901), LXIX., p. 429.

## Chapter Eighteen

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### ARTIFICIAL CIRCLES



ANY injurious circular reactions are associated with the natural processes of pathology. Others are dependent on injudicious therapeutics or social customs. These may be termed Artificial Circles—*circuli factitii*, and various examples have already been described in the preceding pages. Their importance, however, justifies a separate Chapter, which may serve to warn the profession of the evil effects that often result from ill-considered treatment.

**Cathartics.** The excessive use of cathartics, due to the blatant advertisement of the quack or to the impatience of over-zealous disciples of Æsculapius, is responsible for a highly pernicious sequence of events.

Like all other physiological processes, fæcal evacuations vary in frequency and in quantity within the limits of health. Over-stimulation on one day is followed by a period of diminished activity the next day and *vice versa*. By this self-regulating process Nature ensures a sufficiency of intestinal relief.

Unfortunately many persons attach undue importance to trivial deviations from normal defæcation and, forgetful of Nature's powers of adjustment, fly to cathartics whenever there has been a deficient relief. The result is an over-stimulation of the

bowels followed by an aggravated constipation, which is then attacked by larger doses of aperient. So the process continues, resulting in intestinal catarrh and atony, and provoking more and more obstinate coprostasis (**Plate XVII. a**).

Sir Henry Holland many years ago called attention to this sequence of events :

“The habitual irritation of the mucous membrane by cathartics alters and depraves its secretions throughout the whole course of the alimentary canal, becoming thereby a further source of mischief and suffering to the patient. These disordered secretions are too often urged in proof of the need of further evacuation. And thus the practice proceeds in a Vicious Circle of habit from which the patient is rarely extricated without more or less injury to his future health.”<sup>1</sup>

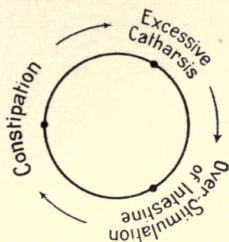
Wilkinson has thus described the injurious effects of excessive purgation :

“The use of drugs requires clinical acumen, common sense and shrewd observation, lest the drugs make matters worse by establishing a still greater inhibition of the ordinary processes, digestive, muscular and nervous, upon which the regular and complete evacuation of the bowel depends. Such want of skill and care may establish a Vicious Circle at one segment of which such severe and distressing conditions as membranous colitis, chronic catarrh and even visceral neurasthenia may obtrude themselves.”<sup>2</sup>

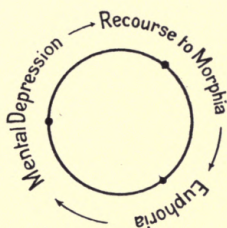
**Morphia.** Another important artefact is associated with the habitual use of morphia and other narcotics (**Plate XVII. b**) ; the *habitué* becomes ensnared within the coils of a habit from which escape is all but hopeless. The drug, while satiating

<sup>1</sup> “On the Abuse of Purgative Medicines.” Medical Notes and Reflections, 1839, p. 100. This is the earliest reference to the expression “Vicious Circle” which I have met with in a medical work.

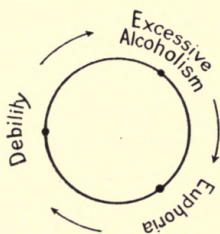
<sup>2</sup> *Practitioner*, 1910, II., p. 638.



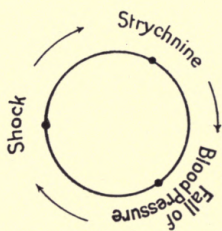
(a) ABUSE OF CATHARTICS



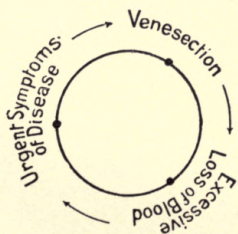
(b) ABUSE OF MORPHIA



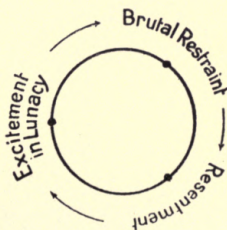
(c) ABUSE OF ALCOHOL



(d) ABUSE OF STRYCHNINE



(e) ABUSE OF VENESECTION



(f) ABUSE OF RESTRAINT

the immediate craving, creates an appetite for further indulgence, and weakens that self-control without which no salvation is possible. As Virgil says: *ægrescit medendo*, "the disorder increases with the remedy."

Tourette writes :

"This condition gives rise to a true Vicious Circle. . . . The morphinomaniac flies to his syringe before meals in order to awaken an appetite which is always indifferent. After meals the injection is repeated in order to assist digestion. . . . As time goes on, the drug is used more and more often and in larger and larger quantities."<sup>1</sup>

Tanzi also describes the condition :

"Each new injection must be larger or more quickly repeated than the preceding one, in order to give the desired effect. Thus a Vicious Circle is established, which gives morphinism the character of a fatally progressive habit."<sup>2</sup>

Morphia has frequently been used in attacks of cardiac dyspnœa, with results which in the long run have proved highly injurious. The drug temporarily relieves distress, but at the same time diminishes the irritability of the respiratory centre and thus allows

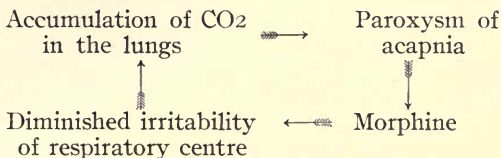
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<sup>1</sup> *Maladies du Système Nerveux*, p. 244. Cf. also Curschmann, *Lehrbuch der Nervenkrankheiten*, p. 903.

<sup>2</sup> *Text-Book of Mental Diseases*, p. 334. Cf. also *British Med. J.*, 1911, I., Epitome, p. 32; Haydn Brown, *Advanced Suggestion*, p. 191. Brown substitutes the expressions "positive or favourable" and "negative circlings" for "virtuous or vicious circles." In another Volume "The Secret of Human Power" the operation of Vicious Circles is discussed. Thus on p. 73 he writes : "In future no organic or functional disorder can be adequately studied without regard for negative and positive circling ; such is the importance of the subject."



more CO<sub>2</sub> to accumulate in the blood. The patient then requires an increasing dose of morphia in order to obtain relief, and a dangerous condition is created which Hirschfelder represents in the following way :<sup>1</sup>



In some cases the patient is so addicted to morphia that he brings on a paroxysm of dyspnœa voluntarily, and of course does himself great harm by so doing.

Similar correlations may be established by cocaine and other drugs whose use leads to repetition, to habituation and finally to volitional palsy. Cocaine may impose an even worse slavery than does morphia.

**Alcohol.** The habitual indulgence in alcohol frequently ends in the establishment of a Vicious Circle, which possesses great interest both for the physician and the sociologist. Indeed it is owing to this complication that alcoholism exacts such a heavy toll in disease, in poverty, in crime and in death.<sup>2</sup>

There are many reasons for the prevalent addiction to alcoholic indulgence. Amongst the commonest are its power of creating a sense of bodily and mental comfort, and of promoting a temporary oblivion of misery and poverty. As we read in

<sup>1</sup> Diseases of the Heart and Aorta, p. 205.

<sup>2</sup> Cf. Chronic Alcoholism and its Vicious Circles, by J.B.H., *British J. of Inebriety*, 1915, II., p. 13. Cf. also Poverty and its Vicious Circles, by J.B.H., p. 56.

the Book of Proverbs "Give wine unto the bitter in soul ; let him drink and forget his poverty, and remember his misery no more."

Moreover alcoholic indulgence is particularly seductive and dangerous, since it does not evoke that sense of satiety which generally attends excess. On the contrary, over-indulgence induces a craving for more ; Nature gives no signal when to stop (**Plate XVII. c**). Self-control is therefore required in order to keep consumption within judicious bounds and that self-control is often lacking. Any primary weakness of volition is further increased by its results, so that the evil is steadily re-inforced.

Stöcker writes :

"Chronic alcoholism always plays a very pernicious rôle, since it leads to the establishment of a Vicious Circle. The injury to the brain caused by excessive use of alcohol provokes a further desire to drink and diminishes the power of resistance to the injurious effects of alcohol."<sup>1</sup>

While every person who indulges regularly in intoxicant liquors is liable in course of time to the evil effects of habituation, neuropathic individuals run the greatest danger, owing to their greater nervous instability.

McBride writes :

"The instability of the nerve force in neurasthenic individuals induces the taking of alcohol, which in turn increases the instability, this leading to excessive use of the stimulant ; and thus the Vicious Circle goes on, to the complete undoing of the victim."<sup>2</sup>

Apart from the mental effects of chronic alcoholism, there are often local disorders which also tend to self-perpetuation. One of them is dilatation of

<sup>1</sup> Beitrag zur Frage der Alcoholpsychosen, p. 296.

<sup>2</sup> The Modern Treatment of Alcoholism and Drug Narcotism, p. 78.

the stomach associated with impaired peristaltic activity. This condition provokes a sense of exhaustion and disinclination for work, which tempts to further indulgence. The dilatation and stasis also tend to flatulence, which aggravates the dilatation.

Horsley and Sturge write :

“In this condition the stomach never contracts fully and effectively so as to expel its contents into the bowel ; hence it always contains some remnants of a meal, which ferment and cause ‘wind.’ This in its turn tends to inflate the stomach and itself to increase the dilatation, and thus the Vicious Circle goes on.”<sup>1</sup>

If the misguided victim still flies to the bottle for relief, he but pursues a will-o'-the-wisp that lures to destruction.

**Bromides.** The incautious use of bromides has done great harm. Few drugs have a stronger tendency to lower the recuperative power of a disordered nervous system. Yet, especially in former days, bromides have been extensively administered to benefit the very conditions in which that recuperative power was lacking.

Traumatic neurasthenia, such as is sometimes caused by a railway accident, may serve as an illustration. Such accidents are frequently followed by spinal tenderness, stiffness and pain, associated with nervous prostration. These symptoms were formerly attributed to irritation or inflammation of the spinal cord, which must be arrested by sedatives, and led to the administration of large doses of bromide of potassium for weeks together. Unfortunately bromide may produce symptoms closely akin to those of traumatic neurasthenia, with the result that unwary practitioners often confused the effects

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<sup>1</sup> Alcohol and the Human Body, pp. 193, 205.

of the bromide with those of the injury and continued to increase the dose. No wonder that the symptoms steadily grew worse. Cause and effect were inextricably confused, further bromide of potassium being administered to remove the very disorder the drug had produced.

A case of litigation is actually on record in which a claim was based on the presence of inflammation of the cord and its membranes as proved by a cutaneous eruption, which eruption was in reality an acne induced by bromide of potassium !<sup>1</sup>

**Strychnine.** Strychnine is another drug which has often been incautiously used, e.g. in cases of post-operative shock, associated with exhaustion of the vaso-motor centres and fall of blood-pressure. Recent research, however, proves that stimulants are useless for the purpose of arresting such a fall. In fact their administration both weakens vaso-motor action and lowers pressure, being tantamount to flogging a tired horse (**Plate XVII. d**). In other words, the presence of shock led to the administration of strychnine, the very drug best calculated to increase shock.<sup>2</sup>

**Iodides.** A grievous artefact has at times been established when potassium iodide has been prescribed for the cure of various forms of dermatitis, and has then provoked an iododerma which is attributed to the original disorder. Increased doses of iodide may be then ordered in ignorance of the real cause of the aggravation, and in the hope of curing the very lesions the drug has produced !

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<sup>1</sup> *Medical Times*, 1885, I., p. 437.

<sup>2</sup> Cook and Briggs, *John Hopkins Hospital Reports*, 1903, p. 470. Cf. also Crile and Lower, *Anoci-Association*, p. 20.

There can be no doubt that death has sometimes resulted from such a lamentable error.

Thibierge writes :

“ The various lesions provoked by iodide of potassium are often mistaken for manifestations of syphilis. This error of diagnosis leads to further use of the remedy, or even to increased doses. Hence result a persistence and aggravation of the eruption.”<sup>1</sup>

Brocq, speaking of iodide eruptions, says :

“ When the true nature of the eruption is not recognized, and the physician consequently persists in the administration of the iodide, the cutaneous lesions rapidly increase in number and severity, invade the mucous membranes, and become hæmorrhagic. Albuminuria, diarrhœa and marasmus gradually supervene, and the patient may succumb.”<sup>2</sup>

The danger is perhaps all the greater from the fact that there seems to be no such thing as *accoutumance* to iodides. One attack of a drug eruption seems to intensify the susceptibility to subsequent attacks.<sup>3</sup>

**Sulphur.** The prolonged use of sulphur in the treatment of scabies occasionally excites a dermatitis that may be mistaken for the original disease and is therefore continued more vigorously than before, with annoying consequences. Indeed such a dermatitis may be kept up for many months, long after all the acari have been destroyed.<sup>4</sup> Sometimes the error is due to ignorance. In other cases neurotic auto-suggestions lead to this prolonged treatment.

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<sup>1</sup> Pratique Dermatologique, II., p. 487.

<sup>2</sup> Dermatologie Pratique, I., p. 412.

<sup>3</sup> Morrow, Monographs on Dermatology, 1893, pp. 367, 500.

<sup>4</sup> Hartzell, Diseases of the Skin, p. 449.



Dubreuilh writes :

"There are some persons who have recovered from scabies, but who, in consequence of the attack and of the treatment adopted, are still suffering from a more or less extensive eczema. They will not believe themselves cured, and worry their doctor to order them more and more active treatment. This only aggravates the eruption and the itching, so that the poor sufferer cannot escape from the Vicious Circle in which he is caught."<sup>1</sup>

**Anæsthetics.** Dangerous correlations may occur during the administration of chloroform, especially if the vapour is administered in too concentrated a form. The danger depends on the anatomical arrangement in virtue of which the heart receives the blood containing the largest quantity of the anæsthetic, which only reaches other portions of the body after passing through the heart.

Meyer and Gottlieb write :

"The heart can be very seriously poisoned by the sudden entrance into it of blood containing too much chloroform, even before any general narcosis has developed. If by such abrupt administration of chloroform the action of the left ventricle is markedly weakened for even a short time, a Vicious Circle is produced, which with each instant augments the damage suffered by the heart. For, as the heart empties itself but incompletely, it is directly exposed to a persisting poisonous action of the blood stagnating in it and containing poisonous amounts of chloroform, and consequently results in death of the heart."<sup>2</sup>

Another injurious sequence often complicates the administration of anæsthetics when there is persistent reflex rigidity, since such rigidity may be accompanied by spasmodic closure of the larynx

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<sup>1</sup> *Pratique Dermatologique*, II., p. 739.

<sup>2</sup> *Pharmacology*, p. 64.

and retraction of the tongue. The resulting non-aëration of the blood may in its turn aggravate rigidity, and give rise to a dangerous complication which must be dealt with by inducing a deeper anæsthesia. This process of reciprocation has already been referred to on p. 206.

Artefacts are by no means confined to drugs ; many illustrations are connected with surgery and surgical appliances.

**Venesection.** Perhaps the most tragic example may be found in the use of venesection as practised for many centuries. Formerly, indeed, venesection was regarded as a panacea for almost every ailment, acute or chronic, and the evidence is only too clear that *venesectio ad mortem* was no uncommon occurrence, death being erroneously attributed to the illness instead of to the loss of blood.

The custom was to bleed until the patient became faint, when recovery was allowed to take place. In the case of some diseases, such as pneumonia, peritonitis and typhoid, where there is fever or pain, some remission of the symptoms followed recovery from the faintness, a remission which was hailed as evidence of the beneficence of the operation, and led to its being repeated again and again, if fever or pain recurred.

When, however, blood is drawn *pleno rivo*, the symptoms produced (palpitation, vertigo, violent headache, jactitation, convulsions, coma) are apt to resemble those of inflammatory disorders, and are then liable to be imputed to a recrudescence of the original mischief, although really due to anæmia. Unwary practitioners confused cause and effect, venesection being repeated to remove the very symptoms it had produced (Plate XVII. e). In fact the more marked the effects caused by the loss of blood, the more freely was blood drawn. Vene-

section was carried to such excess as to kill many patients who would have recovered perfectly if they had been left alone.

The *Lancet* of 1827 records an illustrative case which may be briefly summarized :

A man fell from a scaffold and fractured several ribs. On reaching St. Bartholomew's Hospital early on a Friday morning he was bled 18 oz., and at noon 20 oz. more. The next day a further 18 oz. were taken, and on the following day 18 oz. at noon and 18 oz. in the evening. On Monday the pulse was small and jerking, but very compressible. This condition was regarded as "indicative of inflammation and not resulting from loss of blood or hæmorrhagic irritation." Accordingly bleeding was again ordered to the extent of 18 oz. The dresser in charge of the case, however, alarmed by the condition following the loss of a few ounces, desisted from drawing any more. Nevertheless, when about two hours later two surgeons saw the man in consultation, they ordered 20 oz. more to be drawn. After this the pulse became a mere flutter, death taking place a few hours later.<sup>1</sup>

**Irrigation.** Even so simple an operation as irrigation may be the means of perpetuating the evil it is intended to cure. Thus in cases of gonorrhœa the careless use of the syringe may carry infection from the anterior into the posterior urethra and even into the bladder. Gonococci implant themselves in what has hitherto been virgin soil and frequently excite posterior urethritis, epididymitis and cystitis. The syringe may prove a curse rather than a blessing.

Even vaginal irrigations may be followed by injurious results. They are frequently ordered for a slight increase of the "whites," which are as normal

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<sup>1</sup> *Lancet*, 1827, II., p. 94. Cf. also Copland, Dictionary of Practical Medicine, I., p. 177 ; Hale White, Text-Book of Pharmacology and Therapeutics, p. 915.

for some women as is a slightly increased nasal discharge in others. Such slight leucorrhœa generally cures itself, if left alone.

The habit of douching, however, washes away the normal and sterile acid secretions, destroys the superficial layers of cells and irritates the subjacent layers. Local hyperæmia is thus stimulated, the quantity of secretion is increased, and even menorrhagia may be provoked. When these have supervened intensified douching is prescribed, cause and effect abetting one another.<sup>1</sup>

**Mechanical Support.** Injudicious treatment is sometimes associated with mechanical supports, whose primary effect may be beneficial, while the ultimate result is to increase the disability. For example, in many cases of spinal weakness, mechanical support by the spinal jacket is relied upon for the cure of the muscular weakness. The support increases the spinal weakness, which by degrees requires more and more support. Applying the lesson to a much commoner article of attire, we may say that the corset creates the demand which it supplies.

The same principle applies to the use of irons for weak-boned children, a plan which violates the principles of all sound practice. Unless such treatment is applied with great circumspection, more harm than good may result.

**Restraint in Insanity.** Another illustration is supplied by the general use in earlier days of fetters, hand-cuffs, strait waistcoats and other brutal apparatus for the coercion of the imbecile or the insane. Such restraint, in lieu of promoting amelioration, provoked intense resentment and excitement or even

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<sup>1</sup> Fothergill, *British Med. J.*, 1918, I., p. 445.

permanent mania, the secondary irritation being urged as a plea for further coercion (**Plate XVII. f**). Frequently a temporarily excited or eccentric person was goaded into a condition of permanent lunacy by the treatment that was inflicted.<sup>1</sup>

These atrocious methods, not so long ago universally advocated by the profession, should keep us chastened in spirit, and serve as warnings lest a *nimia diligentia* lead to methods of treatment of which it may be said :

*plus a medico quam a morbo periculi.*



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<sup>1</sup>Gardiner Hill, Non-Restraint System of Treatment in Lunacy, pp. 103 f. Cf. also Griesinger, Mental Diseases, pp. 491 f ; *British Med. J.*, 1910, I., p. 519.



## Chapter Nineteen

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### THE BREAKING OF VICIOUS CIRCLES BY NATURE



ON first thoughts such a self-perpetuating process as a Vicious Circle might be supposed incurable. Indeed the supposition would, in many cases, be justified, as is shewn by the epithets "endless," "eternal," "fatal," "lifelong," "hopeless," "infernal," "unconquerable" which have been applied to this process.

The conclusion that no Circle can be broken would, however, be a serious error. Nature frequently succeeds in interrupting injurious reciprocations. By what mechanism is such a result obtained?

In the Chapter on *Ætiology* it was pointed out that pernicious circular reactions are largely the result of the inter-dependences of organs. When the power of giving vicarious assistance to a diseased organ is unduly taxed, the second organ or series of organs fails to meet the extra demands made upon it and succumbs. Such failure then reacts injuriously on the first, and so the process continues.

The ability to render vicarious assistance varies greatly, being dependent on age, nutrition, environment and other factors. Hence there is an infinite variety in the processes of reciprocation called forth, when injurious reactions have been initiated.

The problem may also be stated thus: In the sum-total of reactions provoked by a primary

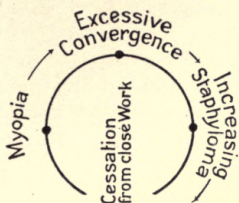
disorder, some are beneficent and some are maleficent. If the beneficent reactions are dominant the disorder takes a favourable course ; the opposite result ensues if the maleficent reactions prevail. This predominance of certain reactions over others then determines the issue, whether in perpetuation, aggravation or recovery.<sup>1</sup>

Where the factors that constitute the Vicious Circle are isodynamic, recovery is impossible. If, for example, in severe pneumonia and secondary cardiac failure there is an equilibration of pathological factors no balance of recuperative forces is left. Again if in the case of pulmonary hæmorrhage, the cough (factor A) expels an ounce of blood from the respiratory passages, while the concurrent increase of blood-pressure (factor B) causes another ounce to escape from the bleeding vessel, the morbid process will continue until death results from anæmia. Or if in pruriginous disease the secondary scratching causes as much fresh eruption and irritation as the *vis medicatrix* cures, we have what Kaposi calls an "endless *circulus vitiosus*." Again if chlorosis causes as much blood to be lost by epistaxis or menorrhagia as can be manufactured by the hæmopoietic organs, no progress is possible. In Trousseau's words, "we shall always be turning round in the same Vicious Circle."<sup>2</sup> Since, however, the beneficent reactions are as a rule predominant, recovery is the rule ; Nature triumphs.

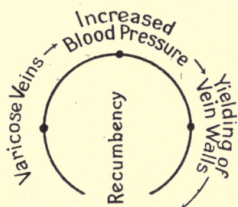
The methods employed by Nature vary greatly. Some of them aim at strengthening one organ in rendering vicarious assistance to another by such simple processes as enforced rest, hypertrophy, dilatation and so forth. In many other cases, however, an extra-ordinary mechanism is called

<sup>1</sup> Allbutt, *Clinical J.*, III., p. 194.

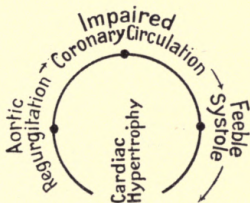
<sup>2</sup> *Clinical Medicine*, V., p. 109.



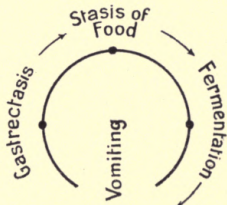
(a) MYOPIA



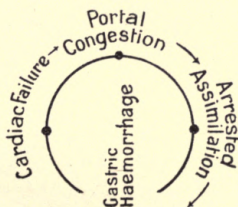
(b) VARICOSE VEINS



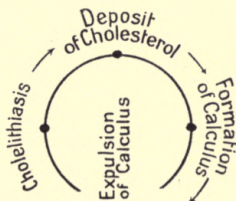
(c) AORTIC REGURGITATION



(d) GASTRECTASIS



(e) CARDIAC FAILURE



(f) CHOLELITHIASIS

into operation ; this is what Parkes Weber calls the "explosive method."<sup>1</sup>

**Rest.** The enforcement of rest is an important method by which injurious circular reactions are interrupted. Thus progressive myopia may be attended by such severe asthenopia that all work involving accommodation must be abandoned. The strain on the ocular muscles during convergence and accommodation is thus relieved ; the pressure on the eye-ball is lessened ; the progressive posterior staphyloma is arrested ; the incessant demands on the visual centres are lightened. Reserves of nervous energy can be accumulated, and after an adequate period of recuperation the self-aggravating factors of progressive myopia are brought to an end. (**Plate XVIII. a**). The abandonment of binocular vision and the establishment of an external squint are other means of securing rest and avoiding the necessity for convergence.

The morbid correlations associated with inflamed varicose veins may be interrupted in a similar way. Enforced recumbency relieves the reciprocally acting tension and dilatation which rendered the disorder a steadily progressive one. The congestion and tension are relieved. In other cases spontaneous clotting may completely arrest the morbid process (**Plate XVIII. b**).

Another common sequence is associated with congestion and prolapse of a subinvolted uterus, causing continuous back-ache, whenever the woman is on her feet. Prolonged rest in bed or on the sofa allows the displaced and engorged organ gradually to return to its normal situation, congestion and prolapse being simultaneously relieved.

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<sup>1</sup> Vicious Circles in Disease and Nature's Efforts to deal with them. *Practitioner*, 1916, II., p. 145.

Rest is also the usual mechanism by which dyspeptic disorders are cured. Here the functions of peristalsis, secretion and absorption are simultaneously impaired, depreciating each other and constituting "a Vicious Circle *in optima forma*." Nature imposes physiological rest by the suppression of appetite, and the production of nausea or pain. Time is thus allowed for the complete digestion of remnants of food, for the removal of disordered secretions and for the building up of reserves of enzymes and further aids to digestion. In other cases increased peristalsis transfers the ingesta into the bowel before they are able to do more mischief.<sup>1</sup> At the same time Nature often awakens a desire for extra exercise, such as a gallop, a stiff walk or out-door game, thus hastening recovery both by stimulating the portal circulation, promoting peristalsis and evacuating the products of imperfect digestion.

Sleep is another of Nature's methods of arresting circular reactions, especially in neurotic disorders which are complicated by insomnia. The obstinate correlations may continue in operation until the neuron threshold is greatly depressed and the victim a complete mental and physical wreck. All at once, as if by the wand of a magician, "tired Nature's sweet restorer—balmy sleep" breaks the Circle.<sup>2</sup>

**Hypertrophy.** Hypertrophy of the heart is an admirable example of Nature's method of arresting processes of reciprocation in many cases of valvular

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<sup>1</sup>Ewald, Diseases of the Digestive Organs, II., p. 485.

<sup>2</sup>There are many other ways in which neurotic Circles may be broken. Dr. Claye Shaw tells of a lady who was cured of insomnia, depression and headache by the very natural process of having a baby. *Lancet*, 1911, I., p. 357.



disease. For example, in acute aortic regurgitation the coronary arteries are inadequately filled, the myocardium is enfeebled, leading to a feebler systole and increased regurgitation. In course of time compensatory hypertrophy will largely make up for the valvular defect, improving the coronary blood-supply, promoting the nutrition of the myocardium, and enabling the heart, even though unsound, to carry on the circulation with a large measure of success (**Plate XVIII. c**).

Another example is seen in cases of portal cirrhosis. In this disorder large numbers of hepatic cells are destroyed, their proteins being absorbed into the circulation, producing hepatic anti-bodies or cytoly-sins, which lead to further destruction of liver cells. This dangerous toxic process may be checked by hyperplasia of the hepatic parenchyma. By this means the evil day may be staved off, although there is always a danger that the progressive cirrhotic process may involve the hyperplastic areas and engulf the new cells.<sup>1</sup>

**Cough.** So physiological an act as coughing may be the means of breaking injurious circular reactions, as, for example, when tuberculous matter is evacuated from the lung, although, owing to many collateral factors, such a fortunate termination is not common. When a tubercular focus has formed in the pulmonary tissues, the bacilli give rise to enzymes and toxins, which weaken and destroy the surrounding cells and provide increasing supplies of food for the bacilli. Thus the latter multiply more and more, and give to tuberculosis its progressive character. Where, however, the circumstances are favourable and the tissues have adequate

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<sup>1</sup> Rolleston, *Diseases of the Liver, Gall-Bladder and Gall-Ducts*, pp. 193, 292.

powers of resistance, this process may be arrested. Indeed the whole tuberculous mass may be loosened and expectorated. The host triumphs over the invader and the morbid process is at an end.

### EXTRA-ORDINARY MECHANISMS

At other times some extra-ordinary mechanism is called into operation in order to deal with the emergency.

**Emesis.** Biliousness is a symptom-complex due to an interwoven chain of disordered functions in which various organs are involved. It frequently originates in some error in diet which disturbs the gastric functions and sets up fermentation, with the production of lactic and butyric acids, which irritate the mucosa and cause it to secrete an excess of mucus which adds fuel to the fire. The irritated stomach ceases to convert its contents into peptones and chyme, and expels into the duodenum semi-digested materials entirely unfit for intestinal digestion and absorption, and which disorder the small intestines. The bile and pancreatic juices are unable to neutralise the gastric juice *plus* the lactic and butyric acids, with the result that the intestinal juices remain acid, instead of becoming alkaline, and in turn irritate the mucosa and provoke the secretion of unhealthy mucus. Simultaneously with these processes angry reflex messages are travelling from the stomach and intestines to the liver and pancreas, perverting the functions of these glands and interfering with the due discharge of their secretions. Moreover the hepatic antitoxic functions are largely arrested, so that the organic poisons which reach it from the portal system continue to circulate, disturbing the functions of the nervous system and giving rise to headache, giddiness and other symptoms. Thus the primary disorder spreads

far and wide, with echoing reverberations from one organ to another.

Nature often breaks the sequence by active emesis. The fermenting ingesta together with the unhealthy secretions of the stomach are expelled, so that the mucous membrane can once again resume its normal activities. The liver is compressed so that the inspissated bile is squeezed out and can once again take part with the pancreatic juice in intestinal digestion. The reflex disorders in the liver, pancreas and other organs are arrested and the complex reciprocations of disturbed functions come to an end. The chain of interacting disorders has been broken.

A similar mechanism may operate in cases of gastrectasis where dilatation and retention aggravate each other. For a long time the usual reflexes lie dormant and peristalsis is in abeyance. But sooner or later the burden may become insupportable. The machinery of vomiting is started and the stomach pumps up its contents, perhaps to the extent of a bucketful. Even a greatly dilated stomach may in this way be again braced up, the unburdening leading to great amelioration or even to recovery (**Plate XVIII. d**).

**Peristalsis.** Attention has been drawn above to the sequence of events occurring during the growth of a biliary, renal or other calculus. For years the morbid correlations may persist, while the victim endures a weary martyrdom. But all at once, without apparent cause, active peristalsis may be called into operation and the offending calculus is expelled. Nature has done the trick (**Plate XVIII. e**).

Again in obstinate coprostasis faecal stasis may lead to paralysis of the intestinal wall, and the paralysis to yet more obstinate stasis. Dangerous correlations are in operation and the condition

appears one of *impasse*. After a period of rest, however, vigorous peristalsis may return and sweep away even a great accumulation of fæces. Such an extraordinary effort, although not free from danger, may be completely successful.

**Decompression.** Many cases of heart failure are aggravated by secondary visceral congestion. Here the *vis medicatrix* may take the form of a sharp attack of gastric or intestinal hæmorrhage ; indeed such a loss of blood is often a blessing in disguise, and prove *vitæ artifex, mortis fugator*. On the one hand the overburdened heart is relieved while, on the other hand, the viscera can resume work and again supply wholesome nutriment to the failing myocardium. The lost equilibrium of the vascular system is restored (Plate XVIII. f).

Uræmia is another disease in which hæmorrhage is common and frequently beneficent. Epistaxis, hæmaturia, melæna, metrorrhagia may occur. Nature bleeds herself ; the organism is its own physician, as Hippocrates pointed out many centuries ago.

**Syncope.** In other cases of hæmorrhage dangerous correlations may be interrupted by temporary cardiac failure. For example, in pulmonary hæmorrhage the intra-pulmonary irritation of the effused blood causes a cough : each act of coughing sends up the blood-pressure : each rise of blood-pressure is apt to renew the hæmorrhage. Under such conditions syncope, instead of destroying, proves the very means of preserving, life. The weakening of the heart's action allows time for the stagnating blood to coagulate within the bleeding vessel and close the orifice. A natural hæmostasis is achieved.

**Inflammation.** The self-perpetuating processes that complicate ringworm are sometimes arrested by means of kerion. Trichophytes may live in the

skin for many years without provoking any obvious reaction. In certain cases, however, when the *tinea tonsurans* has penetrated to the bottom of the hair follicle, an inflammatory reaction, often associated with pyogenic organisms, supervenes, as a result of which the hair is detached from its papilla and is thrown off carrying the parasite with it. In other words the reaction cures the disease by expelling the parasite, and as soon as this has been accomplished the reaction subsides. The attacks of ringworm which appear the most severe frequently have the most favourable termination.

Sabouraud describes the process :

“ There is a whole category of tineas which tend to suppurative folliculitis and give rise to kerion. In these cases an afflux of leucocytes takes place in the follicle and provokes the loosening of the hair, which is detached from its papilla. The hair then acts like a foreign body and is spontaneously expelled or else removed by the slightest traction. In these cases epilation is automatic and recovery fairly rapid ; these are tineas which soon get well. I call them autophagous since the extension of the parasite provokes an organic defence which brings about the expulsion. . . . Kerions cure themselves by a spontaneous epilation.”<sup>1</sup>

Kerion is only one example of the inflammatory process by which Nature is continually breaking the *circuli vitiosi* associated with injury (cf. p. 59).

These illustrations may suffice to shew that the resources of Nature are frequently successful in arresting injurious circular reactions. Her methods are uncertain, clumsy and painful ; nevertheless they often accomplish the end in view. There are, however, many conditions which it is beyond her power to cure. Here Art must succour Nature.

<sup>1</sup> Les Teignes, p. 765.



## Chapter Twenty

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### THE BREAKING OF VICIOUS CIRCLES BY ART



THE breaking of Vicious Circles by the *ars medica* is so extensive a subject as to require a special treatise if anything like justice is to be done to it ; physicians as well as surgeons are perpetually engaged in breaking Vicious Circles.<sup>1</sup> All that can be attempted here is to focus attention on therapeutics as viewed from a particular standpoint.<sup>2</sup>

The treatment of disease when complicated by the *circulus vitiosus* presents problems peculiar to itself. The physician is no longer confronted with a morbid process in which the dominant reactions are beneficent ; these reactions are feeding the disorder. The *vis medicatrix* has become a *vis vastatrix*, and what looms before the sufferer is at best a prolonged disorder, at worst a *descensus Averno*. One teacher writes:—" Let it be a cardinal principle of treatment to make an effort to interrupt

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<sup>1</sup> The treatment of " Vicious Circles from which safe emergence is difficult or impossible," and the restoration of disturbed functional equilibrium is discussed by Carter. *British Med. J.*, 1900, II., p. 1301.

<sup>2</sup> Doubtless this aspect of therapeutics will receive more attention in the future. As a helpful contribution may be mentioned a series of articles by Dr. Sajous on " Vicious Circles in Respiratory Disorders and their Treatment." *New York Medical J.*, 1918, II., pp. 344, 387, 431, 475, 519, 564.

Vicious Circles.”<sup>1</sup> Another says :—“ At all costs the Vicious Circle that has been established must be broken through.”<sup>2</sup> Unfortunately, however, our text-books give but little assistance in the solution of the special problems involved. An attempt must therefore be made to discuss the subject of treatment as influenced by the presence of circular reactions and to illustrate the procedure by some examples.

Therapeutics may roughly be divided into (1) the treatment of the disease, and (2) the treatment of symptoms. Both of these methods are concerned in the interruption of Vicious Circles.

The more important task of the therapist is the cure of the actual pathological condition from which the patient is suffering. By this treatment, which Gilbert describes as “*thérapeutique pathogénique, étiologique ou spécifique—la thérapeutique des causes*,”<sup>3</sup> the cause of the disease is attacked, and when this can be accomplished the effects, i.e. the symptoms, disappear. *Ablata causa tollitur effectus*. Its difficulty consists in the discovery of the actual morbid processes that are at work, and this frequently involves a long and arduous search. Even when discovered the morbid process cannot always be arrested.

The other method, i.e. symptomatic treatment, appears at first sight to be the easier one. Constipation is treated by aperients, hæmorrhage by hæmostatics, pain by sedatives, fever by antipyretics and so forth. To such symptomatic treatment, however, there are serious draw-backs which may become dangerous if it be indiscriminately followed. Attention is concentrated on superficial manifest-

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<sup>1</sup>M. Bruce, *Principles of Treatment*, p. 263.

<sup>2</sup>*British Med. J.*, 1912, II., p. 1459.

<sup>3</sup>Gilbert, *Clinique Médicale*, pp. 34, 38.

ations of disease, instead of on its fundamental factors. Moreover many symptoms are the outcome of Nature's beneficent efforts at resistance and reparation, and such symptoms must be carefully distinguished from other injurious manifestations.

In spite of its attendant dangers, however, symptomatic treatment may be called for by urgent conditions which threaten life or provoke acute suffering. At times indeed the precise nature of the disease cannot be ascertained; in these and similar conditions symptomatic treatment *must* be resorted to, while its associated perils are borne in mind.<sup>1</sup> Such symptomatic treatment, sometimes denounced as unphilosophical, then becomes the height of wisdom and is fully justified by its results. Sajous has so well described symptomatic treatment in relation to Vicious Circles that his remarks may be quoted in full :

“ Interruption of a Vicious Circle, intentionally or unwittingly, appears sometimes to account for persistent benefit from purely symptomatic treatment which could not otherwise be readily explained. Thus cough, whatever be its cause, tends to produce congestion of the lower respiratory passages. This congestion, in turn, promotes local irritability and tends to increase the frequency of the cough paroxysms. These, again, augment the congestion, and a Vicious Circle thereby results which tends to aggravate and perpetuate the disturbance, even though the original cause—usually some form of local irritation—has spontaneously or artificially been eliminated. Administration of a drug, such as codeine, to depress the cough centres in cases of this type, would at first sight appear to constitute merely symptomatic treatment, the beneficial effects of which will disappear when the drug is discontinued, the irritative cause

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<sup>1</sup> An admirable account of the advantages and dangers of symptomatic treatment is given by M. Bruce. Principles of Treatment, p. 135.

of the cough persisting. As a matter of fact, however, the codeine in addition breaks into the Vicious Circle just referred to, preventing the increase of cough due to local congestion, likewise the increase of local irritability due to this cough, and consequently the aggravation and perpetuation of the latter, which would otherwise have occurred through the operation of the Vicious Circle. If at the same time one has succeeded in removing the irritative cause of the cough, complete recovery will be hastened by the artificial interruption of the Vicious Circle; even if one has not, the benefit from the remedy will be far more lasting on this account than if the Vicious Circle has not been present and a purely symptomatic effect alone had been produced. By repeated administration of short courses of codeine treatment the evil effects of the Vicious Circle can be continuously obviated and, through the consequent removal of an important factor of aggravation, a great reduction of the severity and duration of the disturbance is secured.”<sup>1</sup>

As soon as a Vicious Circle has been recognised, an effort must be made to effect a breach at the *locus minoris resistentiæ*, for a signal advantage presented by such a morbid process is that there are at least two points at which the evil round may be attacked. In the words of Lauder Brunton:—“We must see where the Circle can best be broken, since if we break the Circle at one point, we allow recovery to commence.” When the gyration has been stopped, the whirling currents will be restored to their normal direction. The hound which had turned to hunt its own tail will once again be put on the track. Each practitioner will seek to effect a breach at what appears to him the point of election. One will attack at A, another at B, a third at A and B. Hence results a variety of methods which at times puzzles the public, especially when several practitioners are consulted in succession. Yet each

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<sup>1</sup> *New York Medical J.*, 1918, II., p. 344.

may be right in his aims, and the same goal may be reached by different routes. Some illustrations of the *modus operandi* may be grouped under the following heads :—

- I. Hygienic Measures
- II. Drugs
- III. Surgical Appliances
- IV. Surgical Operations

Fuller details as to the Vicious Circles referred to will be found in the preceding Chapters.

## I. HYGIENIC MEASURES

The *ars medendi* can do much both to prevent, and to arrest, injurious reciprocations, when expert knowledge is permitted to regulate life in accordance with physiological righteousness. Only too often, however, is wholesome advice disregarded. The dictates of fashion and the love of self-indulgence generally prevail in opposition to a rational *régime*.

**Rest.** The prescription of rest in bed is often of great benefit. Thus in various forms of cardiac disorder a dilated and over-burdened myocardium is associated with pulmonary and visceral engorgement, the two conditions feeding on one another under the stress and fatigue of the daily activities of life. Recumbency relieves the heart, the warmth of bed stimulates the activity of the skin and assists the kidneys. Improved cardiac, renal and hepatic activity reacts favourably on the lungs ; the relief of pulmonary congestion further invigorates the heart. All these cumulative factors tend to a better circulation and a more aërated blood. Pure blood spells better nutrition of the nervous system, and so by degrees all the organs help one another



in an ascending scale. Brilliant results often follow the prescription of rest in bed for patients threatened with cardiac failure ; even seemingly moribund persons recover and continue in fair health for years (**Plate XIX. a**).

Lauder Brunton emphasises the value of absolute rest :

“ As in many other things the conditions in cardiac disease form a Vicious Circle. The disordered circulation disturbs the function of other organs, and these in turn make the circulation worse. . . In such cases it is evident that the patient is bound to die, and to die a somewhat painful death, unless medical art can afford him some assistance. It is very fortunate, however, that in such cases medical art can do much. . . . If we can break the Vicious Circle at one point, we allow recovery to commence ; and one of the most important agents—I think I ought to say *the most important agent*—in the physician’s power is absolute rest.”<sup>1</sup>

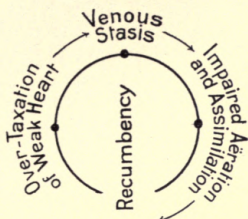
It must, however, be remembered that there should be moderation in all things, and that so valuable a therapeutic measure as rest may be abused. Excessive rest may induce corpulence and throw an extra burden on the heart. A careful course must be steered between Scylla and Charybdis.

In other disorders mental rest is required, as for example in some forms of neurasthenia, where business worries and insomnia are interacting factors. A holiday in Switzerland, an ocean voyage or any similar change of scene that gives rest to the exhausted neurons may quickly and permanently bring relief.

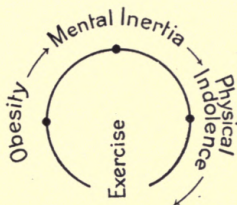
Mental repose is of equal importance in various forms of insanity such as *folie circulaire*.

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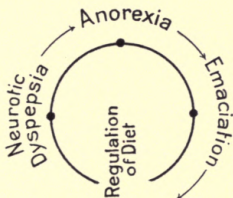
<sup>1</sup>Therapeutics of the Circulation, p. 232. Cf. also Faught, Blood-Pressure, p. 438.



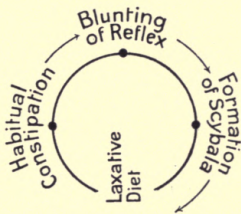
(a) CARDIAC FAILURE



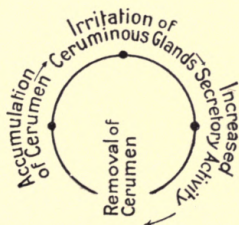
(b) OBESITY



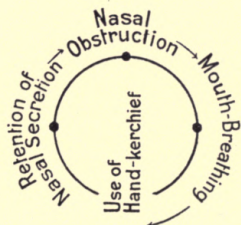
(c) MALNUTRITION



(c) HABITUAL CONSTIPATION



(e) ACCUMULATION OF CERUMEN



(f) NASAL OBSTRUCTION

**Plate XIX.—The Breaking of the Circle by Hygienic Measures.**

Clouston writes :

“The great point in treatment is to prevent the brain getting into the Vicious Circle of continuous alternation, by endeavouring really to complete the cure in all cases of mania—especially in all cases of adolescent mania—and to enforce prolonged quiet and brain-rest after attacks in persons who have shewn a tendency towards recurrence and relapse.”<sup>1</sup>

**Exercise.** The old proverb “What is one man’s food is another man’s poison” applies to exercise as well as to food. Increased exercise in lieu of rest may be required for the interruption of other circular reactions. A common illustration is afforded by dyspeptic disorders associated with anorexia and inertia. Such interacting processes may often be relieved by appropriate exercise. Tissue-hunger is awakened, psychical appetite returns, active gastric secretion and improved nutrition follow. The Vicious Circle is effectually interrupted.

Obesity is another disorder often relieved by exercise, where the accumulated fat hinders activity and so perpetuates itself. The form of exercise to be prescribed depends on the degree of obesity and the individual temperament. Riding, walking, home gymnastics may all render service under suitable circumstances (**Plate XIX. b**). Exercise, when so regulated as to promote cell nutrition, is a valuable means of strengthening the resistance of the body in tuberculosis, and thus forms a valuable curative measure. The severity of the exercise must of course depend on the stage and activity of the disease. But when the temperature is steady at a normal level and the general condition is satisfactory, the exercise may be gradually increased with advancing convalescence. Digestion and nutrition improve, sleep is more natural, physique is strengthened and resistance to toxins is increased.

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<sup>1</sup>Mental Diseases, p. 245.

**Nutrition.** The regulation of nutrition is another valuable therapeutic measure. Many persons, especially young women, habitually eat too little. Either from a dread of corpulence, from want of energy, from dyspepsia or other cause their daily consumption falls below their expenditure. Emaciation results and this may lead to increased inertia and dyspepsia.

Mathieu writes :

“ Many of these patients are enclosed in a veritable Vicious Circle. They have no appetite because they are insufficiently nourished, because they have grown weak, because their processes of metabolism are too greatly reduced.”<sup>1</sup>

The prescription of a suitable diet, so that it may include a sufficiency of protein, fat and other constituents, may in itself suffice to restore both mental and physical vigour (**Plate XIX. c**).

Under other circumstances, such as obesity, restriction of food must be cautiously imposed. The corpulent person will soon begin to feel the benefit of diminished *avoirdupois* ; the *boulimia* created by the malady will be less imperious, and after a few weeks the patient will be less harassed by his self-denial. Frequently also more varied and active occupations will become possible, allowing less leisure for self-indulgence at lengthy meals. Some limitation in the amount of liquid consumed will help in the same direction. Many fat persons imbibe large quantities of fluid which enable them to wash down their food rapidly and throw an extra burden on their circulation. Less fluid will often cause an immediate loss of several pounds owing to a relative drying of the body. Such diminished weight with the concurrent lessened perspiration

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<sup>1</sup> *Maladies de l'Estomac et de l'Intestin*, p. 447.

results in greater comfort and allows more exercise to be taken.

According to Haig a self-perpetuating condition may be associated with a diet which consists too largely of meat. The meat, in his view, by producing uric acid and a state of collæmia, serves as a stimulant, whose action is succeeded by depression. For the relief of such depression, more meat is consumed, and if this fails alcohol is resorted to. A vegetable diet produces less uric acid and less depression, and thus arrests the sequence.

Haig writes :

“Vegetarianism cuts through this Vicious Circle by making it impossible for there ever again to be any great excess of uric acid in the blood, and so removing a cause of the depression which leads to the craving for stimulants.”

And again :

“Meat is a stimulant whose first action is to clear the blood of uric acid, and all substances that produce this effect are stimulants.

Like all other stimulants it produces depression later on when the retained uric acid passes again into the circulation. Hence stimulant taking in one form or another is an inevitable result of meat eating, and here originates the demand for tea, coffee, alcohol, morphine, cocaine, to counteract the secondary depressing effects of the original stimulant.

It follows that there is no escape from this Vicious Circle but the complete abandonment of meat and all the stimulants that have been brought into use by it.”<sup>1</sup>

An interesting Circle associated with nephritis and ascites can often be interrupted by dietetic dechlorinisation. In some forms of nephritis the

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<sup>1</sup> Uric Acid as a Factor in the Causation of Disease, pp. 242, 303, 405, 407, 835, 846.



kidneys lose their power of excreting sodium chloride, which consequently accumulates in the blood, cellular tissues and serous cavities. Owing to the influence of osmosis a considerable quantity of ascitic fluid may collect in the peritoneal cavity, when it may further curtail renal efficiency.

This sequence may be relieved by a diet containing a diminished proportion of salt. For example, a purely milk diet of 2-3 litres *per diem* only contains *ca.*  $2\frac{1}{2}$ - $5\frac{1}{2}$  grms. of salt, whereas an ordinary diet contains 10-12 grms. By a milk diet, therefore, a gradual dechlorinisation may be brought about. Milk also possesses a valuable diuretic action. A similar dechlorinisation may be effected if solid foods which contain but little sodium chloride are consumed, such as meat, eggs, rice and potatoes.

**Hydrotherapy.** Many disorders liable to recurrence are associated with a low power of resistance, which seems to grow lower with every attack of disease. For example, in patients subject to attacks of bronchitis the skin and bronchial tubes become exceedingly sensitive to changes of temperature, the power of reaction being greatly depressed. Lowered resistance, susceptibility to cold, bronchitis, lowered resistance—form an obstinate sequence.

Under such circumstances a careful hardening *régime* may cure the liability to catarrh, and in that *régime* cold baths and affusions, if used with discretion, are of great value. Indeed such cold affusions may establish a power of resistance to bronchial and cutaneous impressions, where debility or sensitiveness previously led to ever-recurrent attacks of catarrh.

**Regularity of Defæcation.** Much harm is done by a habitual disregard of the natural call to stool, since such disregard leads to progressive blunting of the associated reflexes and to increased

constipation. Moreover faeces when retained in the rectum lose much of the fluid constituents by absorption, and produce dry and hard scybala which are difficult of expulsion and favour retention. In this way many persons contract injurious habits. The adoption of such a diet as stimulates the natural desire will in many cases suffice to regulate defaecation and arrest the bad habit that has been formed (Plate XIX. d).

**Cleanliness.** Numerous disorders have been mentioned in which want of cleanliness has initiated disease, which in its turn perpetuates the want of cleanliness. Amongst these are pyorrhœa, accumulation of wax in the auditory meatus, seborrhœa genitalium and intertrigo. Appropriate methods of removing stagnant secretions as a rule readily check the morbid correlations (Plate XIX. e).

The same principles apply to those parasitic disorders in which infection is transferred from one region to another by the fingers and thus starts fresh foci of disease.

**Breathing Exercises.** Nasal obstruction and the resulting mouth-breathing are frequently associated as cause and effect. For example, in weakly children nasal secretions are allowed to accumulate and block the nostrils so that mouth-breathing is resorted to. This in its turn favours the retention of nasal secretions and increases the nasal obstruction. If attended to early, this injurious process can readily be arrested. By an efficient use of the pocket-handkerchief or by induced sneezing<sup>1</sup> the nasal passages can be kept clear, while the habit of nasal respiration is carefully inculcated. Adenoid vegetations would be less common if such nasal hygiene received greater attention (Plate XIX. f).

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<sup>1</sup> *Lancet*, 1918, II., p. 240.

## II. DRUGS

Many Vicious Circles can be broken with the help of drugs, provided these are wisely selected and adapted. The deeper the insight of the physician into the self-perpetuating processes that are in operation the more successful will be his treatment. Remedies should resemble the bullet that flies from the rifle direct to the bull's eye rather than the scattering shot of the fowling-piece.

Space will only permit of a few illustrations, but these will suffice to indicate the *modus operandi*. We shall deal first with some constitutional disorders associated with the nervous, vascular, digestive and other systems, and afterwards with local disorders.

### (A) CONSTITUTIONAL DISORDERS

**Pain and Insomnia.** Pain, insomnia and a lowered neuron threshold form the links of a very common and grievous concatenation, which is met with in various disorders, each link being both cause and effect. An aching tooth, a tender ovary, an over-taxed ciliary muscle, a palpitating heart and so on may fix the consciousness of the sufferer on the lesion, arouse phobias, produce insomnia and steadily aggravate both suffering and misery. Under such circumstances the administration of a narcotic which secures sound sleep may be followed by such raising of the neuron threshold that pain vanishes as with the wave of an enchanter's wand. Evidently the drug acts on the paths by which a lesion affects consciousness ; probably it interrupts those paths at their synapses in the region of the great cerebral ganglia. When irritability has been diminished, the stimuli again become subliminal, and no longer prevent sleep. The sleep further diminishes irritability by allowing time for a renewal of the sub-

stances consumed by the discharge of energy, and thus raising the neuron threshold (Plate XX. a).

There are, of course, many drugs that act as narcotics, but in efficiency none can rival morphia—*τὸ φάρμακον νηπενθές*—"the soothing drug."

As Mitchell Bruce says :

"Rest is urgently required for all cases of this kind, and has to be secured in many instances by means of morphine which breaks the Vicious Circle of unrest and irritability, and, a beginning once made, rest begets rest."<sup>1</sup>

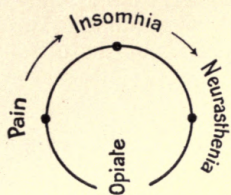
Another condition in which sedatives are invaluable is what has been called the "most highly Vicious Circle in pathology," viz. that which is associated with hæmoptysis and hæmatemesis, and which largely accounts for the profuseness and prolongation of hæmorrhage. Not only does the tendency to cough and vomit suffice to start the hæmorrhage afresh, but the associated mental perturbation and physical restlessness raise the blood-pressure and operate in the same direction. The morphia or other sedative keeps the patient quiet mentally and bodily, thus breaking three Circles simultaneously, and is therefore perhaps the most valuable drug for controlling hæmorrhage.

Morphia is of course only a type of various sedatives that may be used, but it is supreme in its power of dulling over-excitability, and in producing a central hypalgesia. It has a greater power than any other drug "*sedare dolorem—divinum opus*."

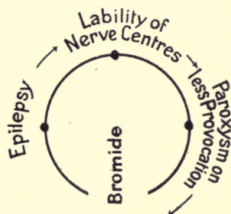
**Epilepsy.** Certain disorders, such as epilepsy, are associated with a progressive proclivity to paroxysms which may be acquired through constant repetition, the attacks being probably due to explosive impulses arising in the cerebral cortex. Every attack in-

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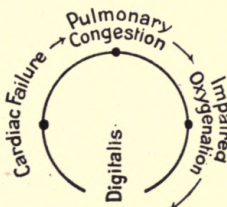
<sup>1</sup> Principles of Treatment, p. 230.



(a) INSOMNIA



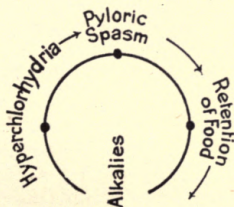
(b) EPILEPSY



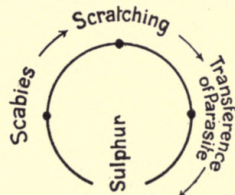
(c) CARDIAC FAILURE



(d) ANÆMIA



(e) HYPERCHLORHYDRIA



(f) SCABIES

Plate XX.—The Breaking of the Circle by Drugs.



creases the labile condition of the nerve centres and after being effect becomes also cause. In other words the neuron threshold is gradually lowered so that a given stimulus more and more readily provokes a paroxysm.

Such exaggerated irritability of the nervous system can be controlled by bromides ; indeed the prognosis in cases of epilepsy has been revolutionised since this treatment has been introduced. In a few cases there are no further attacks even when the drug is discontinued ; the bromide may then be said to have cured the disease. In the large majority of cases (90-95 per cent.), however, the frequency of paroxysms is greatly diminished, or the patient may be entirely free as long as the treatment is kept up, although the attacks return when the drug is discontinued (**Plate XX. b**).

Bromides probably exert their beneficial influence by retarding the passage of impulses along the paths which connect the various motor and sensory centres in the brain. The earlier the fits are arrested, the less fixed will be the proclivity to repetition. Even in the status epilepticus the drug renders service, although that status has other self-perpetuating and dangerous complications which must not be neglected.

Mott thus refers to the status epilepticus :

“To stop the fits early and prevent the establishment of the Vicious Circle by chloral or bromide ; to relieve venous congestion by purgation or enemata ; to support the heart by nutrient enemata and stimulants, and, if necessary, relieve the engorged distended right heart by venesection, appear to be the rational mode of treatment. When people die in the status epilepticus it is often because these measures have not been adopted soon enough.”<sup>1</sup>

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<sup>1</sup>*Archives of Neurology*, I., p. 502.

**Paralysis.** In various forms of paralysis, such as those due to acute anterior poliomyelitis, there is a progressive increase of the disorder owing to loss of the reciprocal relations between the tropho-motor neurons and their corresponding muscle cells. These two elements form but a single unit ; disease of the one involves disease of the other. Sometimes the damaged neurons are unable to transmit any impulses down to the muscles ; at other times these impulses are too feeble to evoke any responsive contraction. In either case the absence of response checks the nutrition, and delays the recovery, of the neurons.

In such conditions the elective action of strychnine on the reflex arcs of the nervous system is most valuable. Even small doses may so raise the irritability of the neurons that they may again become susceptible to peripheral stimuli from the muscles, nutrition and repair thus being promoted. The activities of the receptive organs in the cord and brain, which have been depressed by degenerative processes may in some measure be restored, so that the reflex mechanism again responds to physiological stimuli.

The action of the strychnine is probably localised at some point between the entrance of the affected fibre and the synapse of the motor cell. At that point the passage of impulses through some of the synapses of the spinal cord is facilitated.

**Shock.** In surgical shock various reciprocally acting conditions are present, including a depleted arterial and an engorged venous system, combined with a low blood-pressure and a feeble cardiac activity. As a consequence the vaso-motor centres are inadequately nourished with blood and in severe cases rapidly lose their control over the circulation. In other words the fall of blood-pressure and the inactivity of the vaso-motor centres

re-inforce each other, and the reciprocally acting process frequently ends in death. Under such conditions the intra-venous injection of adrenalin constricts the small blood-vessels and raises blood-pressure. Indeed a full dose of the drug may drive a large volume of blood into the arterial system and flood the tissues with blood, while at the same time it strengthens the cardiac systole by stimulating the myocardium. In both these ways the drug may break the Vicious Circle associated with shock and prevent what appears imminent death. In recent years adrenalin has become one of our most valued remedies owing to the reliability of its action.

**Cardiac Failure.** Circulatory insufficiency may result from disease of the myocardium or of the valves, when the resulting interference with the circulation is not adequately compensated. The principal compensatory change is brought about by hypertrophy of the muscles of one or more of the cardiac chambers, which are thus able to pump out the blood in sufficient quantity and with sufficient force to supplement any deficiency in the circulation. Later on, however, as a result of progressive valvular or myocardial disease or of impaired nutrition, compensation usually breaks down, and stasis supervenes in the pulmonary or systemic circuit or in both, with secondary results—pulmonary, systemic and portal congestion, ascites, œdema etc.—all of which aggravate the cardiac failure.

Under such conditions digitalis and other plants of the digitalis series yield the sovereign remedy for breaking the dangerous Circles that have become established (**Plate XX. c**).

A ventricle which has become insufficient can under the influence of digitalis regain sufficiency. The immediate effect of this will be an improved coronary circulation which in its turn will promote

a more vigorous systole. There will also be a lowering of the excessive peripheral vaso-constriction which has been provoked by the medullary centres in order to keep themselves supplied with blood, but which is no longer required. This will lighten the burden imposed on the failing myocardium.

Thus is brought about an improvement both in the *vis a tergo* and in the *vis a fronte*, as a result of which the blood which had accumulated in the venous system flows more freely to the heart and arteries, thus further benefiting the myocardium. The condition of the blood also improves since the impaired processes of secretion, excretion and aëration are invigorated, and the purer blood tends to more active nutrition.

Another effect of digitalis is to increase the tone of the myocardium and thus to moderate tachycardia. An enfeebled myocardium is compelled to beat rapidly in order to carry on the circulation, even though such rapid action leads to progressive weakening, since the cardiac chambers can neither fill nor empty themselves as they should. With increased tonicity the systolic output is increased, so that fewer beats are required.

Pavlov writes :

"An uncompensated heart beats rapidly and thereby only aggravates its condition. Its time of rest, that is of recovery, of restitution of the organ is shortened. A Vicious Cycle is set up. The weak action of the heart lowers blood-pressure, the lowering of this leads (from known physiological causes) to an increase in the number of beats, the quickening leads to weakening of the organ. Without doubt the digitalis aids by breaking through this Vicious Cycle in that it greatly slows the pulse, and thereby gives new power to the heart."<sup>1</sup>

This slowing action of digitalis is especially beneficial in auricular fibrillation, and may be due

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<sup>1</sup>The Work of the Digestive Glands, p. 233.

to a retarding action on the conductivity of the bundle of His and to a diminished irritability of the motor ganglia in the heart.

As a result of the improved tonicity the auricular and ventricular orifices contract, and this enables the valves, even though damaged, to close the orifices more effectually and thus to lessen regurgitation; there is also less tendency to over-distention during diastole. The increased diuresis brought about by digitalis is of further benefit by relieving the general œdema which so often complicates cardiac failure, and throws so much extra work on the myocardium. The kidneys share in the general acceleration of the blood-flow and secrete more vigorously. The accumulated fluid in the tissues tends to return to the blood-vessels and to be excreted by the kidneys. With diminishing ascites the pressure on the renal veins is relieved and so progress is accelerated.

Thus in various ways digitalis renders brilliant service in cases of cardiac failure; no wonder that it is regarded as a sheet-anchor. Many other drugs are also of value; digitalis has merely been selected as a type.

Opothrapy has also at times been used with success. Some cases of cardiac failure, which Martinet has termed "hyposphyxia," appear to be complicated by hypo-endocrinism, which may be advantageously treated by suitable pluriglandular extracts, in conjunction with physical and other means calculated to strengthen the circulatory function. Martinet believes that in these cases "there is a digestive disorder which reacts upon the circulatory disturbance and forms a Vicious Circle." He therefore treats it with secretin preparations, and and at the same time relieves the endocrinous dyscrasia by pituitary or adrenal extracts, combined, where necessary, with thyroid and ovarian extracts.



Excellent results are said to be obtained from such opotherapy in cases of hyposphyxia following acute infectious diseases, malnutrition, neurasthenia and in the pretuberculous state. "The primary Vicious Circle is broken by this treatment."<sup>1</sup>

**Angina Pectoris.** Angina pectoris is another disorder which is frequently complicated by a Circle, and for which amyl nitrite is used. The drug is most successful in the form of paroxysm known as "angina pectoris vasomotoria," i.e. attacks of vaso-constriction associated with a high blood-pressure. In such cases the effects of amyl nitrite are unsurpassed in certainty.

Allbutt describes this form of angina :

"Vaso-constriction often becomes an active part of angina. A movement or an emotion raises arterial pressure ; by this the sore parts are annoyed and, the medullary centres being irritated, pressures may rise more and more, and a Vicious Circle be established until by nitrites pressures are reduced, or by morphia the centres blocked."<sup>2</sup>

When administered in the form of an inhalation, the drug gives speedy relief, sometimes in less than a minute, and, although the vaso-dilation brought about may only be temporary, the distressing symptoms may be arrested for a considerable period.

Other nitrites, such as sodium nitrite, exert a similar effect to amyl nitrite, although their use is less convenient. On the other hand their effect may last longer.

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<sup>1</sup> Martinet, *Traitement des Hyposphyxies*, *Presse Médicale*, 1913, XXI., p. 635. Cf. also Harrower, *Practical Hormone Therapy*, p. 421.

<sup>2</sup> *Diseases of the Arteries*, including *Angina Pectoris*, II., p. 236.

**Anæmia.** Anæmia is frequently a self-perpetuating condition through its effects reacting upon and aggravating the cause. Hence the chronicity of the disorder.

The administration of iron seems beneficial in all forms of primary anæmia, and arrests the reciprocally acting correlations. It is in the chlorotic form, however, that the drug achieves its most brilliant triumphs. Few drugs can be more confidently relied upon to interrupt the reciprocations associated with a disease; a large proportion of sufferers recover completely. "There is absolutely no question that administration of iron restores the composition of the blood to normal, usually quite rapidly" (Plate XX. d).

In chlorosis there is always a deficiency of hæmoglobin and usually a deficiency of red blood corpuscles, disorders which may be due to insufficient food or to excessive menstrual loss. In a healthy woman's diet, the average daily amount of iron is only 6-8 mgrms. ( $\frac{1}{11}$ - $\frac{1}{8}$  gr.), and, as this only just balances the excretion, a very small margin is left for hæmopoiesis. If, therefore, the average intake is reduced by dyspepsia or if the output is increased by menorrhagia, the body gradually becomes depleted of iron and the hæmoglobin is the constituent which suffers most. Hence result breathlessness, cardiac weakness and œdema.

When, however, iron is taken in addition to that contained in the ordinary food, hæmopoietic activity is gradually increased, and both the proportion of hæmoglobin and the number of red corpuscles increase.

The value of iron has been established not only clinically but by experiments on the lower animals, which show that the drug may not only be utilised as material for the synthesis of hæmoglobin but also exerts a specific action on the blood-marrow and

other blood-forming organs.<sup>1</sup> The combinations of iron as met with in chalybeate waters, such as those of Spa or St. Moritz, are often highly efficient in arresting the morbid process.<sup>1</sup>

**Bronchitis.** Recovery from bronchitis largely depends on the success with which *natura mediatric* can get rid of the large quantity of mucus and other secretions which are poured out into the bronchial tubes and which tend to obstruct the free passage of air. Such expulsion is brought about by means of the ciliated epithelium and of cough, which tend to remove impurities from the lungs.

In severe attacks of bronchitis, however, these natural agencies fail to achieve their object. The retained secretions become infected with bacteria, and destroy the ciliated epithelium. Bronchiectasis and emphysema may also supervene with impaired power of expectoration. Often indeed the bronchiectasis causes stasis and *vice versa*.

These various circular reactions may be more or less broken by expectorants. Some drugs, e.g. carbonate of ammonia, stimulate ciliary action and assist in the removal of secretion, or excite the unstriped bronchial muscles which expel the secretions from the alveoli into the bronchial tubes. Others, such as ammonium chloride, facilitate the removal of secretions by increasing their alkalinity. Yet others, such as terebene or turpentine, may exert some disinfectant action and check bacterial growth. Ipecacuanha both increases bronchial secretions and renders them more liquid, so that the mucus can be more easily expectorated. Moreover

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<sup>1</sup> Chlorosis in plants is due to an insufficiency of iron in the green chlorophyll of plants, and can be cured by the administration of iron. Ward, *Disease in Plants*, p. 180.

the increased secretions sometimes do good by protecting the inflamed and irritable mucosa from cold air and renewed catarrh. Where it is desirable to liquefy tenacious phlegm, creosote or benzoin may be used in an inhaler or a nebulizer. In all these ways injurious circular reactions may be arrested.

**Asthma.** Asthma is another respiratory disorder complicated by a *circulus vitiosus*, which can often be broken by drugs. "Emphysema, bronchial catarrh and diseases of the right heart all increase the tendency to asthmatic attacks, which in turn increase the severity of the complications, and so the patient lives in a Vicious Circle."<sup>1</sup>

No single drug succeeds in arresting the paroxysms in every form of asthma. But stramonium, nitrate of potash, chloroform, morphia may all act as specifics under certain circumstances. By arresting the paroxysms they relieve the correlated disorders which tend to bring on the attacks.

The value of codeine in breaking the Vicious Circle of cough and congestion has already been alluded to (cf. p. 303).

**Anorexia.** Amongst the commonest of disorders of daily life is anorexia or loss of appetite which may arise from a variety of causes.

In a person enjoying good health the following sequence of events establishes a *circulus virtuosus*, or what Mathieu and Roux term a "reflex physiological Circle," in which both central and peripheral reactions take part.<sup>2</sup>

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<sup>1</sup>Short, Index of Prognosis, p. 132.

<sup>2</sup>Mathieu and Roux, Pathologie Gastro-Intestinale, Series IV. (1913), pp. 23, 35.

The ordinary activities of life arouse what is known as tissue hunger due to the need for nutritive materials to replace those that have undergone combustion. This tissue hunger rapidly provokes a cerebral condition which makes itself felt as appetite, and is followed by a flow of digestive juices (appetite juice). The secretion of such juices in its turn reacts on the brain and further stimulates the sense of appetite. If a good meal is now enjoyed, rapid assimilation follows, nutrition is promoted, arousing a desire for exercise, which in its turn awakens fresh tissue hunger and so completes the round.

Under various circumstances, however, this sequence is disturbed and we get in its place languor, absence of tissue hunger, want of appetite, deficiency of gastric secretion, nausea at the sight of food, impaired nutrition, disinclination for exercise and languor. Obviously several arcs of the Circle can be attacked. Active exercise, psychical influences or drugs may all, under suitable circumstances, interrupt the evil concatenation. Here we are merely concerned with drugs. Bitter preparations introduced into the stomach have long been known to possess the power of exciting the appetite. This is followed by a flow of gastric juices which in their turn further stimulate the appetite. Consequently more food is taken, and this is followed by improved nutrition, increased vigour and a desire for exercise. From such exercise result increased metabolism, tissue hunger and further appetite, the *circulus vitiosus* being replaced by a *circulus virtuosus*.

The value of such bitters as strychnine, quinine, gentian and quassia is thus readily intelligible.<sup>1</sup>

**Chronic Gastritis.** Chronic gastritis is often complicated by impaired secretion, absorption and

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<sup>1</sup> Pavlov, *The Work of the Digestive Glands*, pp. 94, 225.



peristalsis, these several factors aggravating each other. Ewald has admirably described the reciprocation of events (cf. p. 93).

Such a self-perpetuating form of gastritis is frequently cured by the administration after meals of dilute hydrochloric or other mineral acid, with which a suitable diet must of course be combined. It is not certain in what way the drugs act. According to Cushny the acid both arrests the lactic fermentation which is so often present, and increases peristalsis. At any rate patients often express themselves as immensely benefited by the remedy, to which some physicians have attributed their great success in curing chronic dyspepsia.

**Hyperchlorhydria.** A remarkable circular reaction is sometimes associated with what is known as Reichmann's syndrome, in which stasis, hyperchlorhydria and pyloric spasm reciprocally perpetuate each other. The syndrome is characterised by paroxysms of severe pain coming on three or four hours after meals and probably connected with spasm of the pylorus. In these cases a dose of bicarbonate of soda frequently gives immediate and complete relief, by neutralising the excess of acid, followed by relaxation of the spasm, the retained food being thus enabled to pass into the duodenum (**Plate XX. e**).

Another plan recommended by Mathieu is the administration of the alkali in small doses as soon as the approach of pain is felt, the dose being repeated every five minutes until the spasm ceases.<sup>1</sup>

The attacks of pain may often be completely arrested by such a treatment extending over a few days.

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<sup>1</sup> Mathieu and Roux, *Pathologie Gastro-Intestinale* (1913), Series IV., pp. 90, 96, 98.

**Gastrectasis.** An obstinate Vicious Circle may complicate the condition of chronic dilatation of the stomach associated with prolonged retention of food. The dilatation conduces to stasis and the stasis to dilatation. The administration of an emetic such as ipecacuanha or sulphate of zinc may at once arrest these reciprocating factors. Even a greatly dilated and over-loaded stomach may again be braced up, the unburdening being followed by renewed tonicity and functional activity. The emesis relieves the stasis, the relief of the stasis cures the gastrectasis.

**Habitual Constipation.** Habitual constipation is frequently due to a neglect of the natural call, the resulting retention of fæces being followed by an undue absorption of their fluid constituents. The reduced mass of dry fæces is then unable to excite adequate peristalsis, so that there is an interplay of cause and effect which accounts for the obstinate coprostasis that is so often met with.

This circular reaction is readily interrupted by a saline cathartic, such as sodium sulphate, which, being but slowly absorbed by the intestines, entails the simultaneous slow absorption of the water in which the drug is dissolved. If therefore a dose of sodium sulphate dissolved in water is administered, a greater quantity of water will reach the large intestine than when a similar quantity of pure water is drunk. The intestinal contents are thus rendered more fluid than usual, and pass more easily on towards the rectum. At the same time the bulk of fluid and the distention of the bowel promote a more active peristalsis and the whole alvine contents are easily evacuated. Many mineral waters such as Carlsbad and Hunyadi Janos owe their efficiency to the presence of sodium sulphate.

Another invaluable drug for habitual constipation is cascara sagrada, since it not only empties the

bowel of fæcal matter but simultaneously acts as a tonic to the intestinal walls, and thus prevents the constipation which follows the use of most aperients.

**Parasitic Infection.** Parasitic infection of the intestines occasionally establishes circular reactions which may be arrested by drugs.

A familiar illustration is presented by oxyuriasis, a disorder in which continual reinfection occurs as a result of the anal irritation. Such irritation, especially in children, leads to infection of the fingers with ova which are then liable to be transferred to the mouth, and eventually regain the intestines.

This Circle may be broken by enemata of quassia. But since the parasites lodge mainly in the cæcum and continue to descend into the rectum in successive swarms during the last four or five out of the six or seven weeks following a single infection, the treatment, to be permanently successful, must extend over this period as a minimum. A pint of quassia infusion for an adult or five ounces for a child will destroy such worms as are lodged in the rectum, and as soon as all the parasites have descended from the cæcum, and have been killed by further injections, a radical cure ought to be effected, provided that no fresh auto-infection has been allowed.

The irritation round the anus may be relieved by the use of a weak mercurial ointment or by sponging with carbolic lotion.

**Nephritis.** Nephritis is frequently a self-perpetuating condition owing to the secondary retention of toxins, which in their turn further impair renal activity. Toxæmia may thus be both cause and effect of nephritis.

The reciprocation may at times be successfully interrupted by a profuse diaphoresis which withdraws large quantities of water together with salts and

toxins by way of the skin, and thus brings relief to the kidneys.

One of the best drugs for the purpose is pilocarpine, by far the most powerful sudorific in the pharmacopœia, and one which, if injected hypodermically, usually produces profuse sweating in ten or fifteen minutes. The diaphoresis lasts about two hours during which as much as two kilos. of fluid may be excreted. The functional activity and nutrition of the kidneys are often greatly promoted and the injurious reactions arrested. The use of such an aperient as magnesium sulphate assists the sudorific by eliminating impurities by the bowel and thus further relieving the toxæmia.

Langdon Brown points out that diaphoresis may be helpful in breaking the Circle associated with chloridæmia :

“ Here we have the clue to the kind of case in which diaphoresis will be of service—namely that in which there is a defect in the elimination of sodium chloride with consequent œdema, for the retained salt increases the osmotic pressure of the tissues, and this tends to increase œdema and to diminish excretion. The elimination of salt by the skin may therefore be of indirect service by breaking a Vicious Circle.”<sup>1</sup>

**Diphtheria.** Space only permits of a brief reference to serum treatment. A notable illustration is afforded by the use of anti-diphtheritic serum, which neutralises the toxins in the tissues and thus arrests their pernicious effects. In other words the serum prevents the death of the cells on which the bacilli are growing. These protected cells therefore are able to resist the invaders, and as a result the local lesion improves rapidly. The fatal tendency to extension is arrested (cf. p. 201).

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<sup>1</sup> Physiological Principles in Treatment, p. 208.

**Tuberculosis.** An example of vaccine therapy is afforded by tuberculin which now asserts its claim, more modest than that originally and arrogantly asserted, of being able to help many and injure none. When judiciously administered in early stages of the disease, tuberculin seems to control the leading symptoms of tuberculosis such as fever, cough, loss of weight and dyspnoea. The sputa and expectorated bacilli gradually diminish and the disease loses its actively progressive character.

**Hypothyroidism.** The value of opotherapy may be illustrated by the use of thyroid extract in cases where hypothyroidism is a self-perpetuating condition as described above (cf. p. 67).

The essential principle is thyreo-globulin, an iodine-containing substance which may be extracted from the follicles of the thyroid gland and used to supplement deficient thyroid secretion. The drug is often successful in arresting the reciprocally acting processes; indeed the treatment forms a notable forward step in rational therapeutics.

## (B) LOCAL DISORDERS

**Glaucoma.** Glaucoma is a remarkable self-perpetuating local disorder. In the words of Priestley Smith "cause and effect react upon each other in a Vicious Circle, and the glaucoma intensifies itself." Nevertheless the morbid process can sometimes be arrested by the use of such a myotic drug as eserine.

It is especially in the premonitory stages and in the inflammatory forms of glaucoma that eserine is of incontestable efficiency. If on the first indications of an attack eserine is instilled into the eye myosis shows itself in from 20-40 minutes, and all the symptoms may be relieved without leaving a trace behind them. As the pupil contracts, the



increased intra-ocular pressure subsides, the cornea becomes clear, intra- and peri-ocular pains vanish, visual acuity returns.<sup>1</sup>

Such treatment may result in a complete cure without the necessity of surgical interference. The value of the drug lies in its power of dilating Fontana's spaces by causing the iris to be stretched in a radial direction and so drawn away from the wall of the eye-ball. Filtration processes are thus promoted. Unhappily, however, symptoms of glaucoma usually return.

**Nasal Obstruction.** The Vicious Circle associated with obstructive hypertrophic rhinitis can sometimes be broken by such a caustic as trichloroacetic acid, which may be applied to the turbinal tissues so as to form linear scars. In a few days the resulting cicatrices contract so that the nasal passages again become patent. In this way the reciprocally acting processes are brought to an end.

**Corns.** Corns owe their persistence in large degree to a self-perpetuating factor. As often as pressure is applied, the central core irritates the hypertrophied papillæ of the corium, as a result of which they are stimulated to increased proliferation. The more the papillæ grow, the more the projecting corn is liable to pressure and *vice versa*. The Circle may be arrested by the application of salicylic acid which causes necrosis of the core of epithelial cells. The entire corn is thus got rid of, including the hypertrophied callosity which previously was continually exposed to pressure and irritation.

**Scabies.** The extension of scabies is largely the result of the itching and scratching caused by the

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<sup>1</sup> Encyclopédie Française d'Ophtalmologie, V., p. 142.

acari, the parasite being transferred from one part of the skin to another by means of the finger-nails.

This very chronic disorder may be cured by a variety of applications, of which the popular and best is sulphur ointment (Plate XX. f). The male parasite remains on the surface of the skin and is readily destroyed by sulphur, but the female burrows under the epidermis so that the epidermal covering of the burrows must first of all be softened by soaking in hot water, and removed by a rough towel. The female parasite will then be exposed and is quickly killed by the ointment.

If at the same time the clothing is disinfected, the circular reactions will be speedily broken and the disease cured.

Similar principles<sup>27</sup> apply to the treatment of pediculosis.

**Pruritus.** Pruritus may be a self-perpetuating condition quite apart from the presence of parasites, and occurs most frequently in connection with certain parts of the body such as the anus or the vulva. So intense may the itching be that the sufferer cannot refrain from scratching, and this, while giving temporary relief, in reality accentuates the trouble. Frequently the scratching even produces organic changes in the skin which lead to further pruritus. Various local applications such as carbolic acid or perchloride of mercury lotions sometimes act like a charm in arresting this obstinate disorder. In other cases a neurotic element is present which needs constitutional treatment.

These few examples must suffice to indicate how drugs may be used to interrupt morbid processes that are aiding and abetting each other. The history of medicine shows that, in the past, much therapeutical gold has been mixed with dross. Even Homer knew that *φάρμακα πολλὰ μὲν ἐσθλὰ μεμιγμένα, πολλὰ δὲ λυγρά*. "Many remedies in the

cup are healing, but many are also harmful.”<sup>1</sup> If disease is studied from the point of the *circulus vitiosus*, i.e. both as cause and as effect, drugs will be prescribed with greater precision as to the end in view ; therapeutics will become more rational and more successful.

### III. SURGICAL APPLIANCES

Surgical appliances are frequently successful in arresting injurious circular reactions ; a few examples will suffice to illustrate their utility.

**Mechanical Supports.** Mechanical supports in the shape of pads or springs often relieve the self-intensifying conditions complicating flat-foot, a disorder which as a rule is primarily due to weakness of the calf muscles, the tibialis anticus and the peroneus longus. Owing to such weakness the plantar arch loses support and subsides, such subsidence being aggravated by the stretching of the supporting ligaments and consequent valgus ; the greater the stretching the more does the arch subside. The concurrent subluxation of the tarsus then throws further strain on the supporting tendons and ligaments, and so the process steadily advances. At other times flat-foot may be caused by some minor traumatic displacement of the tarsal or metatarsal bones. Such displacement causes weakening of the neighbouring muscles which is soon followed by their atrophy and by further flat-foot.

Cyriax writes :

“These displacements often escape notice because they are so slight in amount, or if recognised are considered to be only a trivial secondary result of the flat-foot. Of course, in many cases they are actually secondary, but even then they are of considerable

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<sup>1</sup>Odyssey, IV., 230.

importance, because they form part of a Vicious Circle, and may be aggravating, or at any rate preventing amelioration of, this condition.”<sup>1</sup>

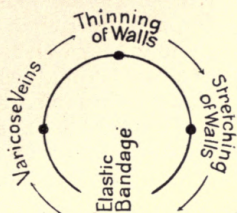
Other sequelae may result from the continual aching and pain associated with flat-foot, which may be so severe as to curtail active exercise. The sufferer in consequence tends to put on flesh, thus throwing further weight on the weakened arch and perpetuating the disorder. The weaker the arch the greater the accumulation of fat and *vice versa*. Treatment depends on the severity of the disorder. In the early stages systematic exercises and massage of the calf muscles, combined with periods of rest, may suffice to effect a cure. But where the mode of life involves prolonged standing with little relief by the exercise of walking, some mechanical support is usually desirable which will retain the arch in its normal position, so that the irritated joints may be rested and the muscles which have been over-stretched and over-loaded through the malposition be relieved from strain. Such mechanical supports, even if only temporary expedients, serve a good purpose until the primary weakness has been corrected by means of massage and improved nutrition.

The treatment of varicose veins by means of elastic bandages is another example of a process of injurious reciprocation being arrested by means of a mechanical contrivance. A well-adjusted bandage supports the weakened vein-walls and prevents further dilatation as well as valvular incompetence (**Plate XXI. a**).

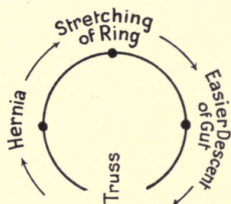
Other illustrations may be found in the application of a truss for hernia, a belt for splanchnoptosis, a jacket for spinal curvature or a pessary for uterine displacement (**Plate XXI. b, c**).

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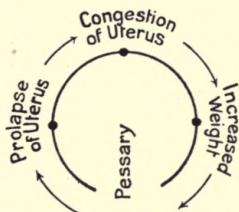
<sup>1</sup> Flat-foot in its Clinical Aspects, *Clinical J.*, 1918, p. 140.



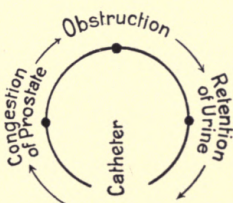
(a) VARICOSE VEINS



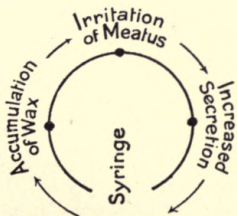
(b) HERNIA



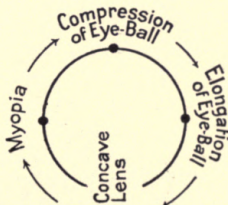
(c) PROLAPSE OF UTERUS



(d) PROSTATIC CONGESTION



(e) ACCUMULATION OF WAX



(f) MYOPIA

**Plate XXI.—The Breaking of the Circle  
by Surgical Appliances.**



**Catheterisation.** Some circular reactions associated with retention of urine which have been described in Chapters VII. and VIII. are frequently arrested by catheterisation. Where congestion has led to retention and retention to congestion, evacuation of the bladder allows the congestion to subside and the sequence to be broken (**Plate XXI. d**). In the case of retroversion of the gravid uterus, associated with retention, evacuation of the bladder is often followed by replacement of the uterus.

Other injurious correlations are arrested by the use of the Eustachian catheter in aural disease.

Obstruction may be also relieved by probes or bougies. Stenoses of the lacrymal duct, œsophagus or rectum are cases in point.

**Hypodermoclysis.** Hypodermoclysis is a method of supplying fluid to the body, which may be of great service in certain self-perpetuating conditions associated with shock or hæmorrhage. Those conditions are marked by a low blood-pressure, with a feebly acting heart, a depleted arterial and an engorged venous system, the anæmic vaso-motor centre having lost control of the splanchnic area. Saline injections of fluid may be the means of restoring the blood-pressure. The heart, which had lost its contractility through want of blood, regains its systolic activity and is able to pump a supply up to the vaso-motor centres. Thus one improvement leads to another, until the morbid process is arrested ; indeed the treatment is often extraordinarily successful. Adrenalin is sometimes added to the solution, as referred to on p. 338. Abdominal or rectal injections may be used for a similar purpose.

Intra-venous injections of hypertonic saline solutions are also successful in interrupting the dangerous correlations that complicate cholera. In favourable cases such injections immediately introduce the stage of reaction ; the circulation is invigorated, the

diarrhœa ceases, the functional activity of the kidneys returns; the elimination of toxins is re-established. The patient who appeared little better than a corpse is resuscitated.

**Irrigation.** Self-aggravating conditions may be arrested by irrigation with syringes or irrigators. Illustrations of such methods may be found in cases of accumulation of wax in the meatus (Plate XXI. e), of coprostasis, of pus in the antrum or the bladder and so forth.

The use of the stomach tube in cases of gastrectasis is another example. Patients are sometimes met with in whom the dilated stomach has so sunk in the abdomen as to form a kink with the duodenum. This kink retards the escape of food through the pylorus, thus causing retention and further gastrectasis. If the retained ingesta are washed out with the help of a stomach tube, the ptosis is relieved; the pyloric kink is abolished and the retention of the ingesta ceases.

**Artificial Lens.** Many disorders have been referred to above in connection with errors of refraction, and can frequently be cured by the use of artificial lenses. For example, in progressive myopia the short-sightedness and the elongation of the eye-ball react on one another. The use of concave lenses removes the near point, relieves the undue pressure on the globe, and checks the progress of the myopia (Plate XXI. f).

Again in hypermetropia the excessive strain on the ciliary muscle frequently produces accommodative asthenopia leading to neurasthenia, headache and insomnia, cause and effect reacting on each other. Here a suitable convex lens may relieve the over-taxed ciliary muscle and give relief.

**Röntgen Rays.** Röntgen rays are of great value in breaking the Circles associated with

trichophytosis ; this treatment constitutes a notable advance in dermatology.

Hitherto the fungus in its retreat at the bottom of the hair follicles has proved inaccessible to attack since no parasitocides could reach it, while every attempt at epilation, owing to the brittleness of the diseased hair, left in the follicle a fragment which sufficed to perpetuate the disease. Fortunately X-rays exert an extraordinary depilatory effect, as a result of which the entire hair in spite of its brittleness is thrown off. So successful and reliable is this method of treatment that a single application of an adequate dose of X-rays for about fifteen minutes will usually cure a patch of ringworm. A few days after treatment all the hair, both healthy and diseased, on the area exposed to the rays is shed, and as soon as the last diseased hair has fallen out, the infection is at an end. In at most twenty-five days after the application of the rays the disease ought to be cured.

Amongst other appliances that are used for arresting circular reactions may be mentioned electrical batteries for cases of paralysis, tourniquets for cases of aneurysm, and cauteries for neoplasms.

#### IV. SURGICAL OPERATIONS

Some Circles can only be broken by the knife of the surgeon. At such times:—*οὐ πρὸς ἱατροῦ σοφοῦ θρηνεῖν ἐπωδὰς πρὸς τομῶντι πήματι* "Skilful leach mutters no spell o'er sore that needs the knife."<sup>1</sup>

The following classification of operations adapted to this purpose will be found convenient :

- I. Organectomy
- II. Organopexy
- III. Organoplasty

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<sup>1</sup>Sophocles, Ajax 581.

- IV. Lithotomy
- V. Stricturotomy
- VI. Tenotomy
- VII. Osteotomy
- VIII. Decompression
- IX. Removal of Neoplasms
- X. Ligation of Vessels
- XI. Drainage

### I. ORGANECTOMY

The total removal of an organ is sometimes required for the arrest of a pernicious circular reaction. Appendicectomy and hysterectomy will serve as examples.

**Appendicectomy.** Appendicitis usually arises from some inflammatory condition which narrows the appendicular duct and causes a retention of secretions. Such retention in its turn aggravates both inflammation and obstruction, and eventually a closed septic cavity results, involving serious illness and even danger to life. Such an injurious sequence may be arrested by appendicectomy (Plate XXII. a).

**Hysterectomy.** Another operation with a similar result is the removal of a bulky, inflamed and procident uterus which is mechanically interfering with the uterine circulation and so contributing to its own enlargement. The procidence is then both cause and effect of congestion, and often can only be effectively remedied by hysterectomy.

Amongst other examples of organectomy that break the Circle are splenectomy for hæmolytic jaundice,<sup>1</sup> cholecystectomy for cholelithiasis, excision

<sup>1</sup> *Lancet*, 1916, II., p. 889.

of the lachrymal sac for dacryocystitis,<sup>1</sup> prostatectomy for prostatic retention and colectomy for intestinal stasis.

## II. ORGANOPEXY

Various organs are liable to undergo displacement, and such displacement aggravates the primary disorder.

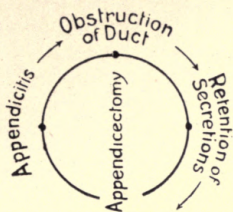
**Gastropexy.** An enlarged and loaded stomach sometimes sinks in the abdomen and pulls down the first section of the duodenum. Hence results a kink which hinders the escape of the gastric contents and provokes further gastropptosis. The more extensive the ptosis the greater the kink and the more obstinate the stasis. Such a displacement may be cured by means of gastropexy which restores the stomach to its natural position and retains it there, either by suturing the organ to the abdominal parietes or by shortening and strengthening the natural supporting ligaments. In successful cases the self-aggravating process is arrested and followed by recovery.

**Hysteropexy.** Hysteropexy is sometimes resorted to for the relief of procidentia uteri. This displacement may be due either to an increase of the forces that tend to depress the uterus, or to weakening of its supports, or to both factors operating simultaneously. In many cases an abnormally bulky and heavy uterus, on the one hand, and a ruptured or weakened perinæum, on the other, are both present. The weaker the perinæum the further the uterus descends ; the further the uterus descends the weaker grows the perinæum. Moreover the prolapsed organs become congested and this congestion intensifies the prolapse.

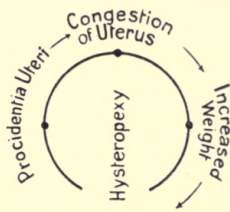
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<sup>1</sup> *British Med. J.*, 1907, I., p. 420.

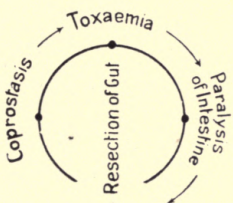




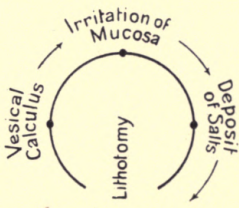
(a) ORGANECTOMY



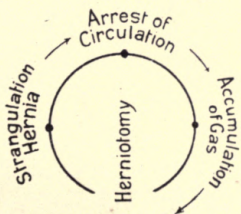
(b) ORGANOPEXY



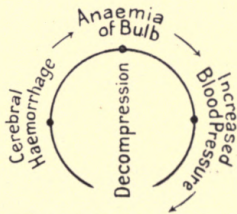
(c) ORGANOPLASTY



(d) LITHOTOMY



(e) STRICTUROTOMY



(f) DECOMPRESSION

Plate XXII.—The Breaking of the Circle by Surgical Operation.

In severe cases neither pessary, tampon nor bandage retain the displaced organ, and some operation is called for. By the strengthening or shortening of the uterine supports the reciprocating process may be checked and the disorder cured (Plate XXII. b).

Colopexy, hepatopexy and nephropexy are other operations with a more or less similar purpose.

### III. ORGANOPLASTY

Under the title organoplasty may be grouped a series of operations devised in order to interrupt injurious correlations.

**Enteroplasty.** Intestinal obstruction creates various such conditions. There may be coprostasis, toxæmia, meteorism, intestinal paralysis and aggravated stasis; coprostasis, kinking of the gut and aggravated stasis; intussusception, increased peristalsis, aggravation of intussusception; strangulation of a hernia, vomiting, aggravated strangulation; enteroptosis, obstruction, aggravated ptosis. Many of these disorders are curable by drugs. But in neglected cases where gangrene threatens or has supervened, enteroplasty is often required. The injured segment is removed, and the two ends of healthy gut are joined end to end or anastomosed side to side (Plate XXII. c).

**Gastroplasty.** Gastroplasty may be called for in the case of gastric ulcers when complicated with hyperchlorhydria, pyloric spasm and retention of the gastric contents. This concatenation of phenomena acting and reacting on each other leads to a grave condition of anæmia, malnutrition and weakness. Various operations have been devised for its relief, including partial resection of the stomach and

gastro-jejunostomy. By either of these operations the stagnation of the gastric contents may be prevented ; the hyperchlorhydria is arrested and the spasm of the pylorus subsides. Pain ceases, appetite returns and the patient regains the weight and strength that had been lost.

**Thyroplasty.** Partial resection of the thyroid sometimes breaks a dangerous complication which may arise when the hypertrophied gland compresses the trachea and narrows its lumen, or by pressure on nerves excites a reflex respiratory spasm. Acute dyspnœa may then result from any exertion that calls the supplementary respiratory muscles into action, since these muscles, in contracting, press the goitre against the trachea, further diminish the lumen and thus increase the dyspnœa ; at times the glottis may be closed by spasm. Unless promptly relieved by operation, the victim dies self-garotted.

Blepharoplasty is another operation which breaks the correlations associated with entropion and ectropion of the eye-lids.

#### IV. LITHOTOMY

Lithiasis includes various disorders associated with the formation and growth of concretions in the tubes and cavities of the body. Such concretions gradually enlarge as a result of interesting circular reactions which have been described in former Chapters and need not be repeated here.

**Lithotomy.** By the operation of lithotomy or litholapaxy the surgeon interrupts these reactions. With the removal of the calculus the irritation ceases ; the excessive deposition of salts and the increased production of mucus are arrested ; the self-perpetuating conditions are brought to an end (Plate XXII. d).

## V. STRICTUROTOMY

Various channels of the body are subject to stricture, a self-aggravating disorder which frequently calls for surgical aid.

**Herniotomy.** A striking example is met with when a coil of intestine is strangled in a hernia or a volvulus. The intestinal walls become acutely congested through constriction of the blood-vessels, while the lumen is distended with blood and gas, such congestion and distension in turn intensifying the strangulation. Frequently the tension causes more gut and mesentery to be drawn within the constricting ring, to become congested and strangled in their turn. By the operation of laparotomy or herniotomy the constriction may be relieved and the circulation restored (Plate XXII. e).

**Urethrotomy.** Another illustration is presented by stricture of the urethra associated with severe straining, hyperæmia of the mucous membrane and aggravation of the stricture. The difficulty of micturition may be so great as to call for urethrotomy, which cures the trouble.

Allied to these conditions are various other forms of strangulation, e.g. paraphimosis, constriction of the prolapsed cervix uteri by the vulvar folds, nipping of prolapsed hæmorrhoids, narrowing of the trachea by hypertrophied thyroid etc. In all these cases operative measures arrest the morbid process.

## VI. TENOTOMY

Orthopædic disorders are frequently complicated by injurious circular reactions which may be arrested by tenotomy.

For example, various forms of clubfoot are met with in which adaptive shortening of the muscles and ligaments has led to displacement of bones and

fixation in an abnormal position. Such displacement, on the principle that performance of function in a wrong position leads to deformity, produces further distortion and shortening, and so the process aggravates itself. Nature, as has been said, cannot cure clubfoot ; it can only render the condition worse. With the help of tenotomy the displaced bones may be brought back to their normal position and the overstretched and weakened muscles restored to functional activity.

Another illustration is afforded by acute anterior poliomyelitis. In the later stages of this disease recovery is checked by the vigorous contracture of healthy opponent muscles. When these have been divided by tenotomy, natural contractions of the paralysed muscles, even though feeble, again become possible and react beneficially on the central lesion. The resulting improvement in its turn promotes further muscular action.

## VII. OSTEOTOMY

Osteotomy is resorted to for the arrest of various *circuli vitiosi*.

Genu valgum or knock-knee frequently starts with a rickety bending of the femur or with some subsidence of the plantar arch, as a result of which the two tibial tuberosities no longer receive an equal weight from the femoral condyles, the outer tuberosity receiving more than its due share. This extra pressure exerted by the external condyle retards the growth of the femoral epiphysis externally, while the growth of the inner condyle is stimulated by the diminished pressure received. Moreover when once the knee-joint is no longer at right angles to the axis of the limb the internal lateral ligament is placed at a disadvantage and stretches. This involves weakness and further mischief. Hence, when once started, this self-aggravating deformity



makes steady progress, since the more the knee yields the greater is the difference in the pressure on the two tuberosities and the greater are the resulting changes.

By means of osteotomy the unequal level of the condyles is corrected, and the limb restored to the straight position. Knock-knee and flat-foot are often simultaneously present, each contributing to the other.

Osteotomy may also be called for in the severe forms of flat-foot, a self-perpetuating disorder which has already been discussed on p. 333. In minor degrees of this disorder massage, exercises and supporting pads suffice. But where the arch has entirely collapsed, tarsectomy may be required for the purpose of restoring the arch and strengthening it by means of bony ankylosis. The most widely practised is probably Ogston's method of denuding the cartilaginous surfaces of the astragalo-scapoid joint, and immobilising the two bones with ivory pegs. There are various modifications, all aiming at arresting the self-intensifying deformity.

Hallux valgus is sometimes cured by means of osteotomy. In this malformation the first phalanx deserts the inner aspect of the metatarsal bone and slips round towards its outer aspect. As a result of this displacement the extensor proprius pollicis, going straight to its insertion, lies towards the outer side of the metatarso-phalangeal joint and thus acquires increased power of aggravating the deformity. The greater the displacement the more injurious the muscular action. By means of osteotomy ankylosis of the metatarso-phalangeal joint may be brought about and the disorder arrested.

Extreme rickety curvature of the legs affords another example of a progressive lesion which may be relieved by osteotomy.

## VIII. DECOMPRESSION

Increased pressure in the cranial and other cavities of the body may be a self-perpetuating disorder involving grave danger to life.

**Trephining.** A striking illustration occurs in ingravescant apoplexy as has been fully described on p. 29. When the hæmorrhage is copious, as frequently happens if the middle meningeal artery is ruptured, the patient usually succumbs to cerebral compression and arrest of respiration, if Nature is left to her own resources. The *circulus vitiosus* becomes a *circulus necator*. By the operation of trephining, however, the effused blood may be removed. The cerebral anæmia is relieved; the blood-pressure falls; the coma subsides. The various bodily functions may almost instantly be resumed as a result of this operation (**Plate XXII. f**).

**Iridectomy.** Decompression is frequently required in the case of glaucoma, a striking example of a self-intensifying disorder, as has been described on p. 175. Apart from operative interference irremediable blindness is not uncommon, while the eye may remain a source of severe and recurrent pain, involving loss of sleep and impaired health. Happily the injurious sequence may be arrested by a successful iridectomy. Still better is an operation which creates a filtering cicatrix, such as a combined iridectomy and sclerectomy, or a corneo-scleral trephining. The increased intra-ocular pressure is relieved, the displaced lens and iris return to their normal position, and the self-regulating mechanism governing secretion and excretion again comes into operation.

**Venesection.** The relief of excessive blood-pressure may also be effected by venesection which may prove a life-saving operation in some cases of failing

heart associated with over-repletion and dilatation. As a result of the heart failure the medullary centres are insufficiently supplied with blood, and in response induce a general vaso-constriction which forces blood to the anæmic centres, thus imposing an extra burden on the already over-taxed heart. The cardiac failure and bulbar anæmia act and react on each other. Phlebotomy may under such circumstances give immediate relief ; the pressure falls, the cardiac dilatation diminishes, the systole increases in force, the viscosity of blood lessens, the dyspnœa subsides, the cyanosis is reduced.

Amongst other self-intensifying conditions which may be relieved by decompression are hydrocephalus, cerebro-spinal meningitis and otitis media.

## IX. REMOVAL OF NEOPLASMS

Many neoplasms owe their growth to reciprocally acting sequences which call for surgical aid ; a familiar illustration is presented by adenoids, a disorder which is closely related ætiologically with chronic catarrh of the nase-pharynx, and in its turn perpetuates such catarrh.

As a result of this morbid process adenoids may grow so large as to block the posterior nares, involving mouth-breathing and other concomitant evils. Their removal interrupts the injurious sequence and exerts a beneficial influence on physical and mental health.

Polypi, again, frequently originate in a chronic catarrh, which leads to the formation of a neoplasm which in its turn perpetuates the catarrh. In other cases new growths may give rise to a Circle by causing mechanical obstruction. This not uncommonly occurs in the intestines, as pointed out by Hook and Kanaval :

“ Strictures and growths, by a partial retention of fæces, develop a Vicious Circle of impaired function

and partial stasis that may end in complete stasis at any time."<sup>1</sup>

Removal of the polypus or new growth brings relief.

Amongst other examples may be mentioned enlarged tonsils, and polypi of the nose, middle ear and other regions.

## X. LIGATION OF VESSELS

Diseases of the arteries and veins, including aneurysms and varices, are often self-perpetuating conditions.

Aneurysm is usually caused either by weakening of the arterial coats, or by strain resulting from a rise of blood-pressure. The more the arterial walls yield the greater the tension to which they are subjected ; the greater the tension the thinner and weaker do they become. Thus the dilatation becomes progressive (cf. p. 57).

In the case of varicose veins dilatation and increased tension also aggravate each other. Incompetence of the valves is a further contributing factor.

By ligaturing the affected arteries or veins the surgeon arrests these reciprocations. The tying of piles supplies another illustration.

## XI. DRAINAGE

Various circular reactions are established by the accumulation of morbid fluids in the cavities and tissues of the body, e.g. effusions associated with pleurisy, pericarditis or ascites, abscesses and cerebro-spinal meningitis. The process of the accumulation varies somewhat in different cases and has been described in previous Chapters. The surgeon is often called in to deal with the morbid processes at work.

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<sup>1</sup> Keen, Surgery, IV., p. 654.

**Paracentesis.** The operation of paracentesis is frequently resorted to in order to remove accumulations of fluid in the pleura, pericardium and peritoneum.

Sajous thus refers to paracentesis of the pleura, which may serve as a type of other operations :

“Tapping may reverse the Vicious Circle into a beneficial Circle, viz. one in which the possibility of respiratory movement, and hence of the pumping action, having been restored, absorption has begun or increased in consequence. The greater the absorption, the greater the respiratory movement and *vice versa*. The beneficial Circle thus established will tend, apparently, to accelerate the rate of absorption beyond what it would otherwise have been. The fact that often the withdrawal of only a small quantity of a large effusion is followed by rapid absorption of the remainder might be accounted for in this way. The underlying absorptive power might not have improved sufficiently to permit of actual resorption, yet have improved sufficiently for resorption when aided by the respiratory movement restored by partial removal of the effusion.”<sup>1</sup>

**Opening of Abscess.** Under the same heading may be placed the drainage of inflammatory swellings or abscesses which are complicated by self-perpetuating conditions. These have been fully described on p. 60.

When an abscess is drained, a multitude of pyogenic bacteria and their chemical products are got rid of. Many beneficent phagocytes and enzymes are lost at the same time, but these are rapidly replaced, so that the ultimate gain far outweighs the loss, and the processes of repair are vastly strengthened. Thus is justified the old surgical aphorism *ubi pus ibi evacua*.

The presence of special microbes may evoke

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<sup>1</sup> *New York Medical J.*, 1918, II., p. 519.



other correlations. For example, bacillus *aërogenes capsulatus* (bacillus *perfringens*) grows rapidly in a blood clot, and produces considerable quantities of lactic acid which in its turn checks the emigration of leucocytes and thus facilitates the rapid proliferation of the bacilli.

Fleming writes :

"When the bacillus *aërogenes capsulatus* grows on blood it produces a considerable amount of lactic acid, and it has been shewn that lactic acid has a very potent action on leucocytes, preventing their emigration. Thus we have a Vicious Circle ; the greater the growth of the bacillus the more is the production of lactic acid and consequently the less is the leucocytic emigration. Unless such a Vicious Circle can be broken the result is likely to be disastrous."<sup>1</sup>

Such a complication merely emphasises the value of modern methods of wound treatment having in view the arrest of the morbid processes at work.

These few illustrations of the applications of surgery to the breaking of Vicious Circles must be looked upon as suggestive rather than as comprehensive. Further illustrations will occur in the practice of every busy surgeon.

Many of the disorders referred to are of the gravest importance and threaten early death unless relief is forthcoming. In the face of such emergencies *natura medicatrix* is usually helpless ; nor are the pills and potions of the physician of much avail. Happily, however, as Hippocrates said centuries ago :

‘Οκόσα φάρμακα οὐκ ἰῆται, σίδηρος ἰῆται.

"What drugs will not cure, steel cures."<sup>2</sup>

<sup>1</sup> *Lancet*, 1915, II., p. 378. Cf. also *British Med. J.*, 1917, I., p. 728 ; 1918, I., p. 369.

<sup>2</sup> *Aphorisms*, viii., 6.

All honour to the surgeon whose art can break the Circle at the *locus minoris resistentiæ* ! Without such aid it would be true of many sufferers to say: *pax illis cum morte solum*.

The more important methods of breaking Vicious Circles have now been briefly discussed, although the subject is far from exhausted.<sup>1</sup> Indeed as Vicious Circles are closely interwoven, in warp and woof, with the processes of disease, so is their arrest intimately concerned with therapeutics. Enough, however, has been said to indicate to the experienced physician how his treatment may be adapted to the particular problem with which he is confronted.



<sup>1</sup> Psychotherapy is often a valuable means of breaking the Circle, and is discussed in "The Vicious Circles of Neurasthenia and their Treatment," by J. B. H. Cf. also Haydn Brown, "Advanced Suggestion," *passim*. Massage, balneotherapy, electricity, physical exercises may also render service under suitable circumstances.

## Chapter Twenty=One

### Conclusion<sup>1</sup>



WE have now completed our survey of the operations of Vicious Circles in animal and vegetable pathology, and pointed out that this morbid process falls into line with other great biological laws to which all higher animals and plants are subject.

The specialisation of structure and function associated with evolution brings unquestioned benefits in its train, since specialisation allows a greater efficiency in the performance of functions. At the same time it involves a liability to injurious circular reactions, when once processes of disease have been initiated.

It is strange that so little attention has hitherto been directed to this self-perpetuating process. Primary reactions are the common-places of text-books of animal and vegetable pathology ; but the reciprocal effects of those reactions on the primary disorder are scarcely thought worthy of consideration, and yet such effects are of far-reaching influence on the natural history of disease. Only too often does each gyration deepen the groove, so that a restoration to normal conditions becomes more and more difficult.

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<sup>1</sup>The following Journals contain articles by the Author dealing with Vicious Circles in disease :—*Lancet*, 1887, I. ; 1908, II. ; 1910, I. ; 1912, I. *British Med. J.*, 1907, I. ; 1910, II. ; 1911, II. ; 1913, I. ; 1914, I. *Practitioner*, 1910, I. ; 1910, II. ; 1912, I. ; 1914, I. ; 1915, II. ; 1916, I. ; 1917, II. ; 1918, II. *Clinical J.*, 1915, I. ; 1918, I. ; 1919, I. *St. Bartholomew's Hospital J.*, 1913, I. *Medical Press*, 1910, II. *British J. of Inebriety*, 1915, II. *Royal Horticultural Society J.*, 1919, Feb. *Veterinary News*, 1918, I.

This subject of injurious circular reactions should appeal to workers in several departments of science. The biologist in the widest sense of that word will find fresh light thrown on the great principle of correlation which plays so important a rôle in the mechanism of life. There is a wide field for research into the reciprocal influences exerted on one another by vital processes.

The zoo-pathologist and phyto-pathologist are still more closely concerned with Vicious Circles, since these exert a potent influence on the phenomena which come under their daily observation. Their therapeutics are largely concerned in interrupting the concatenation of morbid factors.

The central purpose of this Volume, however, is the narrower one of assisting the physician in his efforts to cure disease in man ; only to this aspect of therapeutics is any detailed attention given. No disease of lower animal or plant concerns us so closely as does disease of our own flesh and blood. Moreover organic evolution reaches its highest development in the human species, especially as regards psychical activities. On the other hand psycho-physical inter-dependences render man liable to injurious and complex reciprocations to a degree that is unparalleled amongst less organised animals and plants.

The study of Vicious Circles exerts a fundamental influence on the outlook of pathology. It serves as a constant reminder that diseases, far from being entities, as our ancestors supposed, are due to ever-acting morbid processes in which numerous organs and their functions are closely concerned.

Happily too the subject is not merely of academic interest ; there is profit both as regards diagnosis, prognosis and treatment. By promoting a deeper insight into the complex processes of disease a familiarity with these Circles renders therapeutics more philosophical and more successful.

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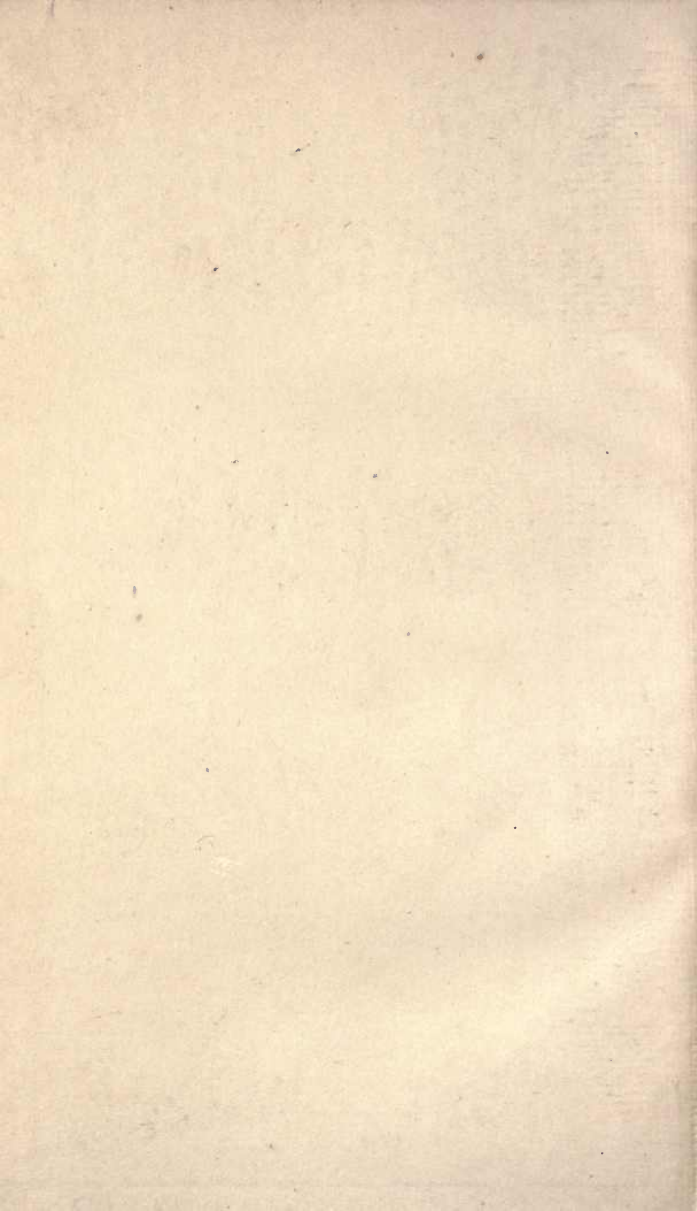


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